United States Department of Agriculture

Terrestrial Wildlife Biological Evaluation

SERAL

Stanislaus National Forest

Pacific Southwest Region

USDA Forest Service

December 2021

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1. INTRODUCTION

The purpose of this document is to evaluate and disclose the effects of the Stanislaus National Forest (STF) Social and Ecological Resilience Across the Landscape (SERAL) project to Threatened, Endangered, and Sensitive wildlife species; pursuant to the Endangered Species Act (ESA) of 1973, the National Forest Management Act (1976), Forest Service Departmental Regulation 9500-004, the Stanislaus National Forest Land Management Plan (USDA Forest Service 1991a), as amended by the Sierra Nevada Forest Plan Amendment (SNFPA) Final Supplemental Environmental Impact Statement and Record of Decision (USDA Forest Service 2004), and/or proposed project plan amendments herein. The STF “Forest Plan Direction” presents the current Forest Plan management direction, based on the original Forest Plan as modified through the Forest Plan appeals and amendment processes (USDA Forest Service 2017) and DEIS Appendix B presents proposed project plan amendments. The content of this document conforms to legal requirements set forth under Section 7, 19 U.S.C. 1536C, and 50 CFR 402.12.

THREATENED AND ENDANGERED SPECIES

Threatened & Endangered, and Proposed species are those Federally listed by the U.S. Fish & Wildlife Service and are subject to Section 7 of the Endangered Species Act (U.S. Fish & Wildlife Service 1998). There are no Threatened & Endangered or Proposed terrestrial wildlife species with known occurrences or suitable habitat within the SERAL project area (Table 1).

Departmental Regulation 9500-004: Direction to Department Agencies for Threatened and Endangered Species

1. Conduct activities and programs “to assist in the identification and recovery of threatened and endangered plant and animal species.”
2. Avoid actions “which may cause a species to become threatened or endangered.”
3. Consult “as necessary with the Departments of the Interior and/or Commerce on activities that may affect threatened and endangered species.”
4. Do not “approve, fund or take any action that is likely to jeopardize the continued existence of threatened and endangered species or destroy any habitat necessary for their conservation unless exemption is granted pursuant to subsection 7(h) of the Endangered Species Act of 1973, as amended.”

REGIONAL FORESTER SENSITIVE SPECIES

Sensitive species are those designated by the Regional Forester with the goal of proactively developing and implementing management practices to ensure that those species do not become Threatened or Endangered, and therefore require protection under the Endangered Species Act because of Forest Service actions (Departmental Regulation 9500-004; Table 1).

Departmental Regulation 9500-004: Direction to Department Agencies for Sensitive Species

1. Assure that the values of fish and wildlife are recognized, and that their habitats, both terrestrial and aquatic, including wetlands, are recognized and enhanced where possible as the Department carries out its overall missions.

2. Consider fish and wildlife and their habitats in developing programs for these lands. Alternatives that maintain or enhance fish and wildlife habitat should be promoted. When compatible with objectives for the area, management alternatives that improve habitat will be selected.
3. Balance the competing uses for habitat supporting fish and wildlife through strong, clear policies, relevant programs, and effective actions to sustain and enhance fish and wildlife in desired locations and numbers.
4. Recognize that fish and wildlife have inherent values as components and indicators of healthy ecosystems, and that they often demonstrate how altered environments may affect changes in quality of life for humans.
5. Avoid actions "which may cause a species to become threatened or endangered".

Table 1. Endangered (E), Threatened (T), Proposed (P), and Sensitive species (S) considered in this analysis (U.S. Fish & Wildlife Service 2021, USDA Forest Service 2014a).

Common Name	Scientific Name	Status	Addressed in detail in this BA/BE
Threatened & Endangered			
None			
Sensitive			
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	S	yes
California Spotted Owl	*Strix occidentalis occidentalis*	S	yes
Great Gray Owl	*Strix nebulosa*	S	yes
Northern Goshawk	*Accipiter gentilis*	S	yes
Willow Flycatcher	*Empidonax traillii*	S	no
Mammals			
Pacific Marten	*Martes caurina*	S	yes
California Wolverine	*Gulo gulo luteus*	S	no
Fringed Myotis	*Myotis thysanodes*	S	yes
Pallid Bat	*Antrozous pallidus*	S	yes
Townsend's Big-Eared Bat	*Corynorhinus townsendii*	S	yes
Invertebrates			
Western Bumble Bee	*Bombus occidentalis*	S	yes

Species are considered in detail where occupancy has been confirmed or where suitable habitat occurs in the project action area and effects are expected. Refer to the Sierra Nevada Forest Plan Amendment FEIS (USDA Forest Service 2004), hereby incorporated by reference, for additional information on species considered in this document.

The SERAL project action area is the project boundary footprint because off-site management actions and potential impacts are not expected (see SERAL DEIS and especially Hydrology and Soils sections). The SERAL project action area is either outside the geographic range or elevation range or doesn't provide habitat for the following species: willow flycatcher and California wolverine. Therefore, those species will not be considered in detail. The following briefly discusses the rationale for not considering these species further:

Willow Flycatcher (*Empidonax trailii*)

Although willow flycatcher (*Empidonax traillii*) has been historically documented on the Stanislaus National Forest, this species has most likely been extirpated from the project area (Siegel et al. 2008). The

SERAL project action area does not contain historical records or areas with suitably large dense willow, wet meadow habitat. Project activities are not expected to result in any disturbance to nesting or foraging willow flycatchers because proposed project activities focus on conifers and restoring forested areas to more resilient conditions. Thus, this species is not addressed in further detail in this document.

California Wolverine (*Gulo gulo luteus*)

The action area is within the historic geographic range of wolverine (USDA Forest Service 2004), but suitable habitat is not present sufficient to meet habitat capability needs for this species. The wolverine is dependent on non-forest alpine habitats associated with permanent snowfields and low human disturbance potential (USDA Forest Service 2004; McKelvey et al. 2008). This habitat type and element are not present in the action area (GIS data; Rich, A., Wildlife Biologist, USDA Forest Service, pers. obs.). The much publicized occurrence of a wolverine near Lake Tahoe was determined to not be ssp. *luteus* and was most likely a widely dispersing individual from the Sawtooth Range (Moriarty et al. 2009). Thus, this species is not addressed in further detail in this document.

2. CONSULTATION TO DATE

An official list of Threatened, Endangered, and Proposed species that could occur in or be affected by the SERAL project was obtained from the Sacramento U.S. Fish & Wildlife Service website on March 3, 2021 and again on September 7, 2021 (U.S. Fish & Wildlife Service 2021). This list is used to identify any species that could be affected by activities in the project area and was used as a basis for determining which listed species should be considered in this document.

The official list did not identify any terrestrial Threatened, Endangered, or Proposed species or Critical Habitat that could occur in or be affected by the SERAL project.

Thus, Pacific fisher (*Pekania pennanti*, southern Sierra Nevada Distinct Population Segment) and Sierra Nevada red fox (*Vulpes vulpes necator*, Sierra Nevada Distinct Population Segment) will not be considered further in this document for the following reasons:

1) The Pacific fisher and the Sierra Nevada red fox are not on the official USFWS ESA list for the SERAL project and as per policy, Pacific fisher and Sierra Nevada red fox are no longer on the Regional Forester Sensitive species list for our Forest (because both Distinct Population Segments are Federally listed now).
2) Pacific fisher, Proposed Critical Habitat, and Sierra Nevada red fox are not present in the project area as evidenced by the USFWS list that uses best available occurrence and habitat data from all sources and by the over 136 camera station and track plate survey results in the SERAL project area conducted by the Forest Service, all negative for Pacific fisher and Sierra Nevada red fox (USDA Forest Service NRIS database).
3) The SERAL project area is below the elevation range for Sierra Nevada red fox and below the elevation range of suitable alpine/subalpine habitat for Sierra Nevada red fox.
4) The past and ongoing sentinel surveys along the northern fringe of the fisher's range provide confidence to detect any northern movements for consideration of fisher needs in the future if necessary. These sentinel surveys are multi-agency and intensive, totaling approximately 50 remote camera stations.
5) In addition, the proposed project actions are all designed to move toward Natural Range of Variation (NRV) for habitat conditions under which the fisher evolved and thus will better maintain habitat for the future by increasing habitat resiliency.

3. PROJECT DESCRIPTION

Refer to the SERAL Draft Environmental Impact Statement (DEIS) for in depth discussion of the alternatives, including those not analyzed in detail. All alternatives comply with all requirements in the current Forest Plan except where amended in Alternative 1 by the California Spotted Owl (CSO) Conservation Strategy (see SERAL DEIS Appendix B). The following are project-specific management requirements pertaining to terrestrial wildlife:

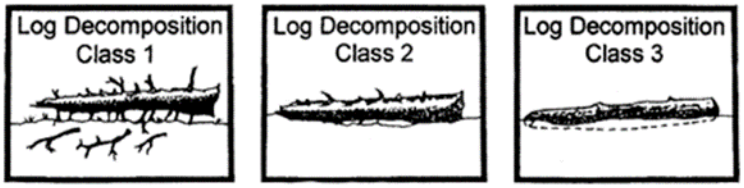
Management Requirements (Terrestrial Wildlife)

1. Prior to implementation, route a site-specific Project Input Form (PIF) and conduct surveys in compliance with the USFS Pacific Southwest Region's survey protocols to establish or confirm current locations of sensitive species and sites, such as nest activity centers and roost sites for spotted owl, great gray owl, and goshawk.
2. Prior to implementing activities within PACs, wildlife biologist review is required to approve layout to ensure current survey results are incorporated and that appropriate buffer distances are in place to avoid nest activity centers and roost sites, including alternate nests and roosts for California spotted owl, great gray owl, and goshawk.
3. In Alternative 1, mechanical treatments may only occur in up to one-third (100 acres) of California spotted owl PACs.
4. Maintain a limited operating period (LOP) prohibiting mechanical operations within 0.25 mile of activity center points during the breeding season for California spotted owls (March 1 through August 15), northern goshawks (February 15 through September 15), great gray owls (March 1 through August 15), marten den sites (May 1 through July 31), and within the specified distance of the known bald eagle nest (January 1 through August 31) as per the National Bald Eagle Management Guidelines. LOPs may be lifted by a Forest Service biologist based on non-nesting status or if a biologist determines that a particular action is not likely to cause breeding disturbance given the intensity, duration, timing, or specific location of the activity.
5. Retain the largest snags and down logs available at the rates listed in Table MR1. Snag retention should be prioritized by size as follows (from highest to lowest priority): (1) very large snags (>36-inch DBH); (2) large snags (> 24 inch DBH); (3) medium snags (>15inch DBH). A snag is defined as a dead tree greater than 20 feet in height. Large down log retention should prioritize the largest size classes of logs with a minimum of 20 inches diameter at midpoint and decay classes 1, 2, and 3 (Figure MR1, USDA 2017, S&G 10).

Table MR 1. Snag and down log retention rates.

Location		Snag Retention Rate	Down Log Retention Rate
Within Fuelbreaks	Inner Core	No retention required	No retention required
	Outer Core	2 of the largest per acre	2 of the largest per acre
Outside of Fuelbreaks	Mixed Conifer and Pine Forest Type	4 of the largest per acre	4 of the largest per acre
	Hardwood Forest Type	4 of the largest per acre	4 of the largest per acre
	Red Fir Forest Type	6 of the largest per acre	4 of the largest per acre

Figure MR1. Decay Classes



6. If nesting or foraging habitat in PACs is mechanically treated for fuelbreaks, mitigate by adding acreage to the PAC equivalent to the treated acreage wherever possible. Add adjacent acres of comparable quality wherever possible (Table B.1 SPEC-CSO-GDL-03).

7. Notify a US Forest Service Wildlife Biologist if any Federally listed or Region 5 Forest Service Sensitive species are discovered during project implementation so that LOPs or other protective measures can be applied, if needed. Include necessary clauses in agreements and contracts to require notification.

8. Ensure PAC, Territory, or HRCA DBH limits are met as defined in table below (DEIS Table S-2):

   Table S-2 from DEIS:

Land Allocation	Tree Type	Alt 1.	Alt. 3	Alt. 4
California Spotted Owl PAC	All Trees	20”	30” – in WUI defense	No Treatment
California Spotted Owl Territory or HRCA	Shade-Intolerant[1]	24”	30”	20”
	Shade-Tolerant[2]	30”	30”	20”
Outside of California Spotted Owl PACs, Territory, HRCA	Shade-Intolerant	30”	30”	20”
	Shade-Tolerant	34”[3]	30”	20”
Within 66 feet of Rust Resistant Sugar Pine[4]	All Conifers	40”	40”	30”
Within 66 feet of Live Aspen Stand[4]	All Conifers	40”	40”	30”
Within a Meadow[4]	All Conifers	40”	40”	30”

[1] Firs, cedars
[2] Pines
[3] Where at least one 30 inch DBH shade-intolerant tree is left within one tree height of tree removed
[4] These exemptions may not be applied within California Spotted Owl PACs, Territories, or HRCAs.

9. For Alternative 1, aim to locate the NRV-based salvage actions in the interior of highly disturbed areas to retain disturbed corridors along green forest edges (e.g., within 325 feet of green forest edge as in findings of Jones et al. 2020a) because green forest edges may provide potential owl foraging habitat in the short-term (USDA 2019, Approach 1, 7b and 7c).

10. For hazard tree abatement where nest stands occur within 250 feet of roadsides, consider alternatives to felling such as temporary road closure or nest structure creation by topping the hazard.

ALTERNATIVE 1 (Modified - PROPOSED ACTION)

This is the Proposed Action, as described in the Notice of Intent (Federal Register Vol. 85, No. 137, Thursday, July 16, 2020 p. 43205-43206) with modifications made in response to public comment and collaborative feedback (SERAL DEIS). Alternative 1 – the modified proposed action, was developed to meet the purpose and needs of the project in collaboration with Yosemite Stanislaus Solution collaborative group. Actions proposed in Alternative 1 include, the construction and maintenance of fuelbreaks, prescribed fire, understory and surface fuel reduction, forest thinning, and non-native invasive weed control and eradication treatments. The proposed actions included in this alternative were crafted to adopt the management approaches and conservation measures presented in the 2019 Conservation Strategy for the California Spotted Owl in the Sierra Nevada (hereafter referred to as the CSO Strategy), including a suite of project-specific forest plan amendments to align the Stanislaus National Forest Land and Resource Management Plan with the direction of the CSO Strategy. The CSO Strategy is a strategic framework for active conservation of the California spotted owl on National Forest System lands in the Sierra Nevada (USDA Forest Service 2019). Since the release of the CSO Strategy in 2019, the 2020 and 2021 fire seasons in the Sierra Nevada further illustrate the urgent importance of adopting management recommendations in the strategy and the best available science in the strategy.

ALTERNATIVE 2 (NO ACTION)

Alternative 2 (No Action) is the “no action” alternative. Under this Alternative, no actions would occur.

ALTERNATIVE 3

Alternative 3 represents a version of the modified proposed action developed in compliance with current management direction as written in the Stanislaus National Forest Land and Resource Management Plan (USDA Forest Service 2017). Alternative 3 does not include any project-specific forest plan amendments or adopt the management approaches or conservations measures presented in the CSO Strategy. For Alternative 3 details, see the SERAL DEIS incorporated here by reference.

ALTERNATIVE 4

Alternative 4 represents an alternative which was developed to comprehensively address comments and concerns as well as incorporate suggestions received during the scoping period. Like Alternative 3, Alternative 4 has been developed under the direction of the current Stanislaus National Forest Land and Resource Management Plan, does not adopt the CSO Strategy or include a forest plan amendment. Unlike the other action alternatives, however, Alternative 4 does not include the salvage of drought, insect, disease, or fire killed trees, temporary road construction, or herbicide use for the control and eradication of non-native invasive weeds. For Alternative 4 details, see the SERAL DEIS incorporated here by reference.

PROJECT ACTION AREA

The SERAL action area occurs at elevations ranging from 1,064 feet to 7,863 feet. This landscape is comprised of vegetative communities that include yellow pine / dry mixed conifer, oak woodland, shrub, fir / moist mixed conifer, and herbaceous types (Table PAA1). Riparian areas are also present. The majority of forested area is mixed conifer which includes ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*Pinus jeffreyi*), incense cedar (*Calocedrus decurrens*), sugar pine (Pinus lambertiana), white fir (*Abies* *concolor*), , and black oak (*Quercus kelloggii*). Red fir (*Abies magnifica*) and western white pine (*Pinus monticola*) occur at higher elevations near 7,000 feet. Plantations are also present throughout the project area and consist mainly of ponderosa pine. Other tree species found include canyon live oak (*Quercus crysolepis*), blue oak (*Quercus douglasii*), big-leaf maple, (*Acer macrophyllum*), dogwood (*Cornus nutallii*), and Douglas fir (*Pseudotsuga menziesii*). Riparian areas contain aspen (*Populus tremuloides*), cottonwood (*Populus balsamifera*), alders (*Alnus incana*, *Alnus rhombifolia*), and willows (*Salix* spp.). Common understory species present include green leaf and white leaf manzanita (*Arctostaphylos patula*, *Arctostaphylos viscida*), deer brush (*Ceanothus integerrimus*), snowberry (*Symphoricarpos rotundifolius*), chinquapin (*Chrysolepis sempervirens*), whitethorns (*Ceanothus cordulatus*, *Ceanothus leucodermis*), buck brush, (*Ceanothus cuneatus*), gooseberries (*Ribes* spp.), birchleaf mountain mahogany (*Cercocarpus betuloides*), and bear clover (*Chamaebatia foliolosa*). Toyon (*Heteromeles arbutifolia*) and chamise (*Adenostoma fasciculatum*) occur in lower parts of the river canyon.

Table PAA1. Dominant habitat types in the SERAL project area (from F3 datasource which is raster based so acres may differ slightly from vector-based sources).

General Vegetation Type	Total Acres / Percent of Total (NFS and non-NFS lands)	NFS Land Acres / Percent of Total NFS Lands (NFS lands only)
Yellow Pine / Dry Mixed Conifer	73,030 / 61%	58,143 / 61%
Oak Woodland	21,421 / 18%	17,737 / 19%
Shrub	15,321 / 13%	11,736 / 12%
Fir / Moist Mixed Conifer	6,753 / 6%	6,113 / 6%
Herbaceous	1,104 / <1%	489 / <1%
Non-Vegetated	1,166 / <1%	562 / <1%
TOTAL	118,795 / 100%	94,779 / 100%

The total analysis area boundary encompasses 118,795 acres (or 118,808 acres from vector-based sources). Unless otherwise specified, the area used to analyze the direct and indirect effects on wildlife and wildlife habitat is about 94,779 acres of National Forest System (NFS) lands within the project boundary. An additional 24,016 acres are not NFS lands. The analysis area is based on 1) the area of impact to forest vegetation from proposed project activities as the project boundary, and 2) furthest measurable extent of noise disturbance levels as ¼ mile from the boundary that would occur as a result of implementing any of the proposed actions. This analysis is bounded in time for short-term effects (up to 20 years) and long-term effects (up to 50 years).

The project area is 1) severely departed from NRV and 2) extremely vulnerable to large high-severity wildfire that threatens mature forest habitat and human communities. Departure from NRV is shown in detail by GIS products and models and in the SERAL DEIS.

Vulnerability to large high-severity wildfire is illustrated by recent examples in the project footprint such as the Quarter Fire, Tunnel Fire, Lyons Fire, and the Bald Fire (Figure PAA1). All four incidents were unplanned fire starts that were fortunately detected early and had sufficient firefighting resources available. Important wildlife resources such as California spotted owl Protected Activity Centers (CSO PACs) were at risk. Protected activity centers are 300 acre areas for special forest management designed to approximate a core area that receives heavy California spotted owl use (Verner et al. 1992). These incidents represent “near misses” or “close calls” of potential uncontrolled, large high-severity fire to important wildlife sites and resources. These incidents demonstrate the urgent need to increase the pace and scale of land management to reduce fire risk in the SERAL landscape using the best available science (USDA Forest Service 2019).

Case 1. Quarter Fire, June 2020. The Quarter Fire was first detected on a sideslope of the Middle Fork Stanislaus River Canyon. Despite starting early in the fire season, growth potential was high based on slope position and fuel conditions. Were this fire to escape containment, it was expected to immediately threaten at least 15 CSO PACs and the communities of Sugar Pine and Mi-Wuk Village.

Case 2. Tunnel Fire, August 2020. The Tunnel Fire was controlled at just one acre attributed to a rapid response by fire personnel. This fire was dangerously positioned to align with Beardsley Canyon threatening a King Fire type scenario and jeopardizing at least 12 CSO PACs.

Case 3. Lyons Fire, May 2021. The Lyons Fire origin occurred somewhat in a bowl and was expected to burn in all directions, jeopardizing at least 15 CSO PACs.

Case 4. Bald Mountain Fire, July 2021. The Bald Mountain Fire was first detected on a side slope of the South Fork Stanislaus River Canyon. This fire was discovered in the morning and was already very actively burning and five acres in size with forward spread and spotting. Growth potential was extreme, and this fire had high potential to "blow up" and burn thousands of acres at high-severity. The location of this fire start, and existing fuel loads, weather, and fire behavior indicated this fire was on a trajectory to potentially burn at least 19 CSO PACs at high-severity. This fire also threatened to burn several human communities at high-severity including Cold Springs, Camp High Sierra, Strawberry, and Pinecrest. Fortunately, enough firefighting resources were available at the time; it took 2 airtankers, 2 helicopters, 3 hand crews, 2 dozers, 2 water tenders, and 6 engines to contain this fire.

Figure PAA 1. Recent "close calls" in the SERAL project area, i.e. actual fire starts with extreme growth potential (CSO PACs shown as green polygons, fire origin as colored circles, and expected fire direction indicated by red arrows).

4. ASSUMPTIONS

The following assumptions were applied to this analysis:

- This analysis assumes all project actions follow all project requirements.
- This analysis assumes that the pace and scale of treatments increases over the past (see Purpose and Need) and that treatments are completed within a short time frame (within about 5-15 years).
- This analysis assumes that temporary roads ("temp roads") follow best management practices for soils and hydrology and are sufficiently blocked and decommissioned after use such that they return to a natural state in a short time frame (typically < 5 years). Temp roads are limited in extent and potential for impact by requirements and best management practices (BMPs) including the following (see Soils and Watershed Management sections in the SERAL DEIS): 1) remove crossing structures and restore stream channels and natural hillslope drainage, 2) ensure road is effectively drained (e.g. waterbars, dips, outsloping) and treated to return the road prism to near natural hydrologic function, 3) block road to prevent vehicle access, 4) treat and stabilize road surfaces through subsoiling, scattering slash, and/or revegetation, 5) reshape and stabilize side slopes as needed, and 6) subsoil or decompact all temporary roads project wide to a depth of 24 inches, except where high rock content, slope, moisture content, depth to restricting layer, and erosion hazard would limit subsoiling feasibility. The need for temp roads is estimated to be minimal, less than 1 mile per 1,000 acres treated and < 26 miles in the entire project area. In addition, previous temp roads would be reused whenever possible to further minmize potential impact. Because the use of temporary roads is limited in scope, intensity, and duration for this project spatially and temporally, potential impacts are expected to remain well below threshold levels for effects on terrestrial wildlife. Similarly, road reconstruction and maintenance activities will comply with the Forest Plan and follow best management practices for soils and hydrology and potential impacts are expected to remain well below threshold levels for effects on terrestrial wildlife.
- This analysis tiers to Risk Assessment documents (https://www.fs.fed.us/foresthealth/protecting-forest/integrated-pest-management/pesticide-management/pesticide-risk-assessments.shtml) prepared by the Region for the use of herbicides, borate, and bark beetle pheromone, and are here incorporated by reference including SERA 2004, 2007, 2010, 2011a-d, 2014, and 2016a-b. These documents show that the use of these materials for the management of nonnative invasive weeds, root diseases, and bark beetle tree protection in this project would not be of sufficient scale or scope to impact any terrestrial wildlife species (see SERAL DEIS for a description of specific agents proposed for this project). The toxicity exposure scenarios analyzed in the risk assessment show that all hazard quotients (HQs) are several orders of magnitude less than the NOAEL threshold of concern or No Observable Adverse Effect Level. Known infestations of nonnative invasive weeds in the 118,808 acre SERAL project area currently total only about 200 acres. This is because the Forest's weed management strategy focuses on small, newly established infestations (see Invasive Plant Risk Assessment) and does not map or address (other than standard best management practices and preventative measures such as requiring clean weed-free equipment) widespread well-established nonnative weeds (e.g., cheatgrass) for which direct treatments would be cost-prohibitive and/or ineffective. Thus, the use of herbicides is expected to entail very targeted and limited spot treatments primarily focused on new infestations. New infestations are typically small and are a priority for treatment to prevent spread across the greater landscape. This technique is called "Early Detection and Rapid Response" (EDRR) and follows many successful examples used in Burned Area Emergency Response (BAER) actions (U.S. Department of Interior 2016; Reaser et al. 2020). Following the EDRR strategy, other integrated weed management techniques such as hand-pulling or mulching will primarily be used so herbicide use would be further limited and only used as a "last

resort". Additionally, hand-pulling and mulching activities are also expected to not be of sufficient scale or scope to impact any terrestrial wildlife species directly through that activity (i.e. noise or ground disturbance). Instead, EDRR actions simply promote native plants and ecosystem integrity long-term for the benefit of all terrestrial wildlife. Likewise, the use of bark beetle repellents is expected to be minimal and limited to targeted use of individual trees such as special high-value trees in campgrounds, administrative sites, or nest trees in PACs.

- This analysis tiers to the DEIS analysis for salvage occurring in Alternative 1 as a rapid response prescription option covered under the umbrella of forest management. That analysis is incorporated here by reference (see SERAL DEIS). Potential effects are considered under forest management because 1) any salvage (other than hazard trees) would be NRV based, 2) any potential rapid response salvage represents a prescription change that overlaps forest management acres analyzed, and 3) specific spatial and temporal constraints have been put in place to minimize potential effects. Any salvage proposed outside of those constraints would be subject to post-disturbance environmental planning and analysis, opportunities for public engagement, administrative review, and decisions (36 CFR 218). A summary of the spatial and temporal constraints include (see SERAL DEIS for detail):

  1) must be driven by a NRV need, e.g., salvage of wildfire-killed trees may only occur when patches burned at high severity exceed 10 percent of the landscape, and salvage of insect, beetle or drought killed trees would not occur when mortality patches are less than 10 acres in size, or until multiple patches comprise more than 15% of the landscape,
  2) salvage may not occur within ¼ mile of an eligible Wild and Scenic River,
  3) salvage of wildfire-killed trees may not occur within PACs (Protected Activity Centers),
  4) salvage of wildfire-killed trees is limited to the interior of highly disturbed areas to retain disturbed corridors along green forest edges [e.g., within 325 feet of green forest edge as in findings of Jones et al. (2020a) because green forest edges may provide potential owl foraging habitat in the short-term (USDA 2019, Approach 1, 7 a, b, c, and d)],
  5) salvage of wildfire-killed trees is limited to a maximum of 500 acres per HUC 6 watershed totaling approximately 3,000 acres within the project area,
  6) salvage of wildfire-killed trees may only occur within 7 years of the SERAL Decision,
  7) salvage of insect, disease, or drought killed trees may only occur within 0.25 miles of maintenance level 2, 3, 4, and 5 National Forest System (NFS) roads,
  8) any temporary roads constructed to complete the salvage action must remain less than 500 feet in length and must ensure all sensitive resources are protected from harm,
  9) salvage must target smaller diameter accumulated fuels which wouldn't exist historically because regular, low-intensity fires would have prevented their existence, and salvage must retain the largest standing snags to provide legacy large logs that then become incorporated into the future forest structure (see management requirements), and
  10) no salvage is authorized to occur if the watershed condition exceeds the Threshold of Concern (TOC).

5. DATA SOURCES

a. CWHR (California Wildlife Habitat Relationships, https://wildlife.ca.gov/Data/CWHR).
b. CNDDB (California Natural Diversity Database, https://wildlife.ca.gov/Data/CNDDB).
c. NRIS (Natural Resource Information System, Natural Resource Manager | US Forest Service

(U.S..gov), https://www.fs.U.S..gov/managing-land/natural-resource-manager).

d. Stanislaus National Forest Geographic Information System (GIS) layers.
e. Project survey reports and incidental detection records.
f. F3 and ForSys products and modeling (Huang et al. 2018; Ager, A. at https://www.fs.usda.gov/rmrs/people/aager).
g. Satellite imagery and forest inventory data including eVeg (USFS R5 RSL).
h. Scientific publications, reports, and other sources cited in References section.

6. EFFECTS OF THE PROJECT ALTERNATIVES

The following section includes species and habitat accounts along with effects analysis for all alternatives considered in detail. Indicators are identified to analyze and compare effects among alternatives.

DIRECT AND INDIRECT EFFECTS

Direct effects are effects that are caused by the action and occur at the same time and place. Indirect effects are effects that are caused by the action and are later in time or farther removed in distance but may still be reasonably foreseeable (40 CFR 1508.8).

CUMULATIVE EFFECTS

According to the Council on Environmental Quality (CEQ) NEPA regulations, “cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions (40 CFR 1508.7).

The analysis area used to analyze the cumulative effects on wildlife and wildlife habitat is about 118,808 acres and includes all lands within the SERAL project area. This area provides an appropriate context for the reasonable determination of effects to species and habitat. Relevant cumulative effects from other projects that have or will treat areas within or adjacent to the action area were considered and included in the cumulative effects analysis (SERAL DEIS Appendix A). This analysis is bounded in time for short-term effects (20 years) and long-term effects (50 years) and relies on current environmental conditions as a proxy for the impacts of past actions. Existing conditions reflect the aggregate impact of all prior human actions and natural events that affected the environment and might contribute to cumulative effects. All activities listed and described in the DEIS Appendix A are not expected to affect all species considered in this document. See individual species analysis sections for further discussion of relevant present and reasonably foreseeable future actions.

Bald Eagle: Affected Environment

Species and Habitat Account

The bald eagle (*Haliaeetus leucocephalus*) is a Region 5 Forest Service Sensitive species. The bald eagle breeds primarily in specific and localized large rivers and lakes of the northern third of California, with scattered nesting throughout the state (Jackman and Jenkins 2004).

Bald eagles typically nest in live trees, some with dead tops, and build a large (~1.8 m/6 ft diameter), generally flat-topped and cone-shaped nest usually below the top with some cover above the nest (Jackman and Jenkins 2004). In general, bald eagles require a large tree to accommodate a large nest in a relatively secluded location within the range of their tolerance of human disturbance (Ibid.). The entire breeding cycle, from initial activity at a nest through the period of fledgling dependency, is about 8 months (Buehler 2020). Diurnal perch habitat is characterized by the presence of tall, easily accessible often dominant trees adjacent to shoreline foraging habitat (Buehler 2020). Bald eagles may roost and perch in relatively small trees but prefer tall trees; the average nest tree size documented in California used by bald eagles is 43 inches DBH and 131 feet tall (Lehman 1979). Bald eagles primarily eat fish and focus nesting, roosting, and perching behaviors within 500 feet along shorelines (Jackman and Jenkins 2004).

The project is within the current distribution of bald eagle in California which has an estimated population of greater than 350 pairs (CDFW 2021b). There is one known bald eagle nest in the project area on National Forest and it is located at Beardsley Lake. Nesting has occurred at Beardsley Lake for at least 18 years. Although nest trees have changed over this period, the nest site has consistently been in the same general stand on the Beardsley Lake shoreline. After 18 years of being occupied as a bald eagle territory, it appears the carrying capacity of Beardsley Lake is limited to one breeding pair. Bald eagles also use the Beardsley Lake area and the Stanislaus River canyon during migration and for overwintering (NRIS Wildlife database). There is also a bald eagle nest at Lyons Reservoir. The nest is located on private land and the shoreline around Lyons Reservoir. This area is owned by Pacific Gas and Electric (PG&E) and Sierra Pacific Industries (SPI).

Risk Factors

USDA Forest Service (2001) summarized risk factors potentially influencing bald eagle abundance and distribution:

1. Nest site disturbance.
2. Loss of habitat and habitat components such as potential nest or roost trees.

Indicators

The following indicators focus the effects analysis on risk factors that relate to project activities. Indicators are based on risk factors described in the best available scientific literature,and form a basis for analyzing potential effects and determining how well project alternatives comply with management direction.

Indicator 1: Potential forest management activities near nest or roost trees (at variable distances following U.S. Fish and Wildlife Service 2007).

Metric = acres.

Indicator 2: Potential forest management activities altering habitat adjacent to occupied lake shorelines near nest or roost trees (at variable distances following U.S. Fish and Wildlife Service 2007).

Metric = acres.

Management Direction

Current management direction for bald eagle is to follow all law, regulation, and policy as it relates to bald eagle because the species is still vulnerable to potential disturbance impacts and is still within the delisting monitoring period (U.S. Fish and Wildlife Service 2009). Forest Plan Direction (USDA Forest Service 2017) pp. 42-43 states: When nesting bald eagles are found, implement suitable restrictions on nearby activities based on the Regional habitat management guidelines and the habitat capability model for the species. Protect all historic and active nests, as required by the Eagle Protection Act and the Migratory Bird Treaty Act.

The Eagle Protection Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who disturb nest sites by substantially interfering with normal breeding, feeding, or sheltering behavior (U.S. Fish & Wildlife Service 2007).

The Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703-712, prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. The MBTA was enacted in 1918; a 1972 agreement supplementing one of the bilateral treaties underlying the MBTA had the effect of expanding the scope of the Act to cover bald eagles and other raptors.

Habitat management guidelines to follow for bald eagle are provided by the National Bald Eagle Management Guidelines (U.S. Fish & Wildlife Service 2007).

For timber operations and forestry practices, the guidelines state:

1) Avoid clear cutting or removal of overstory trees within 330 feet of the nest at any time.
2) Avoid timber harvesting operations, including road construction and chain saw and yarding operations, during the breeding season within 660 feet of the nest. The distance may be decreased to 330 feet around alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched.
3) Selective thinning and other silviculture management practices designed to conserve or enhance habitat, including prescribed burning close to the nest tree, should be undertaken outside the breeding season. Precautions such as raking leaves and woody debris from around the nest tree should be taken to prevent crown fire or fire climbing the nest tree. If it is determined that a burn during the breeding season would be beneficial, then, to ensure that no take or disturbance will occur, these activities should be conducted only when neither adult eagles nor young are present at the nest tree (i.e., at the beginning of, or end of, the breeding season, either before the particular nest is active or after the young have fledged from that nest).

Bald Eagle: Environmental Consequences

Alternatives 1, 3, and 4

All action alternatives follow the National Bald Eagle Management Guidelines that describes what types of activities may occur within specific buffer distances in bald eagle territories (U.S. Fish and Wildlife Service 2007), therefore potential effects are expected to be similar and are analyzed together.

DIRECT AND INDIRECT EFFECTS

Indicator 1. Death, injury, and disturbance are potential direct effects to consider for bald eagle (USDA Forest Service 2004). Disturbance issues are expected to be most pronounced near nest sites (U.S. Fish & Wildlife Service 2007). To limit disturbance, a LOP will be in place unless surveys confirm that nesting is not occurring on a given year, or if a biologist determines that a particular action is not likely to cause breeding disturbance given the intensity, duration, timing, or specific location of the activity. The risk of death or injury are low because the nest locations are known and will be protected as per the National Bald Eagle Management Guidelines (U.S. Fish & Wildlife Service 2007). Birds roosting elsewhere have high mobility so the likelihood of direct interaction with project activities is extremely low.

Indicator 2. Proposed vegetation management actions such as fuel reduction treatments may occur adjacent to Beardsley Lake which is within an area bald eagles could use to nest and forage. Fuel reduction treatments such as forest thinning and prescribed fire may affect smaller potential roost trees, but tall trees would be protected by DBH limits and the shoreline habitat would remain highly suitable for bald eagle. Additionally, most of the potential fuel reduction treatments are located > 660 feet from the historic nest stand at Beardsley Lake (i.e. beyond the avoidance distance identified in the National Bald Eagle Management Guidelines [U.S. Fish & Wildlife Service 2007]). Any project activities within 660 feet of current nest sites must comply with the National Bald Eagle Management Guidelines according to treatment type.

CUMULATIVE EFFECTS

The STF Schedule of Proposed Actions (SOPA) was searched and inquiries were sent to adjacent land managers to determine present and reasonably foreseeable future actions on STF land, other public land, and private land (DEIS Appendix A).

Federal lands: Recreational use adjacent to Beardsley Lake is the only present and foreseeable action on Federal Lands. Recreational use of Beardsley Lake is limited to existing and mostly quiet uses in this area (i.e., primarily parking and day use). There is a small campground on the shore opposite the nest. Based on continued nesting by the bald eagles at this location, these recreation activities do not affect bald eagle behavior. Land around Lyons Reservoir is private so there are no present or foreseeable actions on Federal Lands in that area.

State lands: State lands are very limited in the SERAL project area (less than 40 acres) and there are no present or reasonably foreseeable future actions.

Private lands: There are no private land activities within one half mile of the known nest site or within 500 feet of Beardsley Lake. At Lyons Reservoir, Pacific Gas and Electric (PG&E) does regular dam maintenance and allows hiking, biking, and fishing around the lake. There is no swimming or boating allowed, and the shoreline is closed to motor vehicles, other than one parking area, and maintenance vehicles for PG&E. Because most of the area surrounding the lake is closed to motorized use, Lyons Reservoir is typically quiet and disturbance potential to bald eagles is minimal. Approximately 101 acres of timber harvest are currently planned by Sierra Pacific Industries within 500 feet of the shoreline of Lyons Reservoir, but Timber Harvest Plans (THPs) include protection measures for bald eagle as per State of California regulations. The circumference of the lake is about 21,900 feet and unit boundaries are along 2,350 linear feet (11%) of that circumference, so approximately 89% of the near-shore habitat would not be directly affected. THPs indicate the units have tree retention and are not clear-cuts, so it is likely that overstory trees would remain within units as well.

The small amount of proposed fuel reduction work near Beardsley Lake and Lyons reservoir is not expected to add significant cumulative effects to bald eagles or habitat. The area of proposed work is small relative to the habitat surrounding these reservoirs, known nest sites will be protected, and bald eagle populations in California are increasing (CDFW 2021a). The cumulative contribution of proposed actions in Alternatives 1, 3, and 4 on bald eagles is considered minor and is not expected to add significantly to potential effects of other actions. However, the effectiveness of landscape scale fuel reduction treatments in reducing fire risk vary by alternative (see DEIS fire and fuels analysis) and large high-severity fire is a potential threat to bald eagle and habitat (see Alternative 2 below). Alternative 1 reduces high-severity fire risk the most and Alternative 4 the least.

Alternative 2

DIRECT AND INDIRECT EFFECTS

Indicator 1. Under no action, death, injury, or disturbance would not occur from project activities, but is more likely to occur from wildfire in the long-term than in the action alternatives. The risk of large and high-severity wildfire within the project area is extremely high under no action.

Indicator 2. Fuel-reduction treatments would not occur and the risk of large high-severity fire would remain extremely high. High-severity fire would likely result in loss of habitat for bald eagle. For example, during the 2013 Aspen Fire on the Sierra National Forest, high fire severity resulted in the loss of a bald eagle nest tree (Rich, A., Wildlife Biologist, USDA Forest Service, pers. obs., Figure BAEA1).

Figure BAEA 1. Bald eagle nest tree lost to wildfire. Sierra National Forest, 2013.

CUMULATIVE EFFECTS

The cumulative effects discussions under Alternatives 1, 3, and 4 outline those present and foreseeable future activities scheduled on public and private lands. Under Alternative 2, no actions would be implemented as a result of the SERAL EIS.

Under Alternative 2, cumulative effects would not result from project activities (no actions would be proposed) but may occur if a large and high-severity wildfire were to occur. Large high-severity fires have been increasing in the Sierra Nevada and the risk within the project area is extremely high (see DEIS, fire and fuels section). The cumulative impact of the increasing acreage of areas burned by large high-severity fires appears to be on a significant trajectory potentially affecting many wildlife species including bald eagle (Figure BAEA 1 and Figure CSO 3).

Bald Eagle: Determination

ALTERNATIVES 1, 3, AND 4

Alternatives 1, 3, and 4 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the bald eagle in the planning area. This determination is based on the following rationale:

- The project will follow the National Bald Eagle Management Guidelines to prevent death, injury, or disturbance.
- These alternatives include actions to reduce the risk of nest and roost site loss from high-severity fire. Risk reduction is most effective in Alternative 1.

ALTERNATIVE 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the bald eagle in the planning area. However, Alternative 2 would increase risk factors to bald eagle and habitat in the long-term. This determination is based on the following rationale:

- Short-term disturbance from project activities would not occur, but the risk of disturbance from high-severity fire would be high long-term.
- Fuel reduction would not occur, and the risk of high-severity fire would remain high.
- At the individual scale, taking no action would likely affect two bald eagle nest sites because of the risk of large high-severity fire.

Bald Eagle: Compliance with Management Direction

This project complies with forest plan direction and the National Bald Eagle Management Guidelines (U.S. Fish & Wildlife Service 2007) by avoiding disturbance and habitat modification within specified buffers.

Great Gray Owl: Affected Environment

Species and Habitat Account

The great gray owl (*Strix nebulosa*) is a Region 5 Forest Service Sensitive species and is listed as Endangered under the California Endangered Species Act (USDA Forest Service 2014a, https://wildlife.ca.gov/Conservation/CESA). In North America, the great gray owl (GGO) occurs from Alaska to northern and south-central Ontario, Idaho, Montana, Wyoming, central Saskatchewan, northern Minnesota, and California (CWHR, Wu et al. 2016). In California, great gray owls occur in the Sierra Nevada from the vicinity of Quincy and Plumas County, south to the greater Yosemite area (CWHR, Wu et al. 2016).

Hull et al. (2010) and Hull et al. (2014) found that great gray owls in the greater Yosemite area (including the Stanislaus National Forest), are a genetically-unique population warranting subspecies status as *ssp. yosemitensis*. The genetic analysis completed by Hull et al. (2010) indicates that the *S.n. yosemitensis* population has experienced a recent genetic bottleneck and exhibits a small effective population size. The limited genetic diversity in this population may contribute to population instability because of the already low population levels, low census numbers, limited migration potential, and the potential for inbreeding depression (Ibid.).

Great gray owls are regarded as locally rare throughout their range in USFS Region 5 with around 100-

200 individuals in California (Hull et al. 2010). Although the great gray owl population in California is small, the Stanislaus National Forest contains more great gray owl sites than any other National Forest in Region 5, or any area outside of Yosemite National Park (Siegel 2001 and 2002, NRIS Wildlife Database). Of the great gray owl sites on the Stanislaus National Forest, most are located in areas that border Yosemite National Park.

Suitable habitat for great gray owls is represented by large meadows surrounded by forest with high canopy cover and large trees (Bull and Duncan 2020). Vegetation types include Sierra Mixed Conifer, White fir, Red fir, Montane Hardwood, Montane Hardwood Conifer, Wet Meadow, and Ponderosa Pine, size class 4 and 5, moderate and dense canopy (CWHR, Van Riper III and Van Wagtendonk 2006). Breeding female home range size has been estimated at 152 acres while winter home ranges average 6,072 acres; male breeding home range has been estimated at 49 acres while winter home ranges average 5,221 acres (Van Riper III and Van Wagtendonk 2006). Great gray owls typically nest in dense canopied forested stands adjacent to meadows or meadow complexes in large broken-top snags. Most detections of great gray owls are within 300 meters of meadow habitat (Green 1995, Van Riper and Van Wagtendonk 2006, Winter 1986). Availability of nesting structures and prey may limit the use of otherwise suitable habitat. Green (1995) found that occupied great gray owl sites had greater plant cover, vegetative height, and soil moisture. Canopy closure was the only variable of three variables measured (canopy closure, number of snags greater than 24 inches DBH, and number of snags less than 24 inches DBH) that was significantly higher in occupied sites versus unoccupied (Ibid.). Adults exhibit high nest site fidelity, with 78 percent returning to within 0.6 miles of the previous year's nest site (Bull et al. 1988b). Not much is known on dispersal patterns in great gray owls. Bull et al (1988a) reported that maximum dispersal distance for juvenile owls to be 4.6 and 19.9 miles from their natal sites. Great gray owls aren't considered migratory, though adults make short elevation movements during winter, presumably to areas with lower snow depths (Hayward and Verner 1994).

The diet of great gray owls may vary locally, but consists of small mammals, primarily rodents (Bull and Duncan 2020). Current literature (Beck and Winter 2000, Bull and Duncan 2020, Kalinowski et al. 2014, Powers et al. 2011) indicates that great gray owls in the western United States overwhelmingly select two prey taxa: voles (*Microtus* spp.) and pocket gophers (*Thomomys* spp.). Voles prefer wet meadows with dense herbaceous vegetative cover approximately 5 to 14 inches high (Beck 1985, CWHR, Greene 1995, Kalinowski et al. 2014). Gophers are typically subterranean but are positively associated with drier areas of meadows (Kalinowski et al. 2014, Powers et al. 2011). Compaction of meadow soils may reduce suitability of areas for gophers (Powers et al. 2011).

Recent burns and open grassy woodlands provide some structural similarity to a meadow ecosystem for a few years before the trees or brush shade out the grasses and forbs (Beck and Winter 2000). Such sites can provide foraging areas for nearby breeding great gray owls in the short-term (Greene 1995, Polasik et al. 2016). Meadows or meadow complexes at least 25 acres in size appear to be necessary for persistent occupancy and reproduction but meadows as small as 10 acres will support infrequent breeding (Beck and Winter 2000). Reproductive sites are associated with high vole abundance and high vole abundance is associated with meadow vegetation height (Beck 1985, Beck and Winter 2000, Greene 1995, Kalinowski et al. 2014, Sears 2006, Wu et al. 2016).

Protected activity centers (PACs) are established and maintained to include the forested area and adjacent meadow around all known great gray owl nest stands (USDA Forest Service 2004). The PAC encompasses at least 50 acres of the highest quality nesting habitat (CWHR types 6, 5D, and 5M) available in the forested area surrounding the nest. The PAC also includes the meadow or meadow complex that supports the prey base for nesting owls. Surveys are conducted for great gray owl to follow up reliable sightings (USDA Forest Service 2004). PAC assessments and surveys for great gray owl are being conducted in the SERAL project area prior to implementation.

Surveys for great gray owl have been completed across the Stanislaus National Forest (NRIS, Siegel

2001, 2002) and as part of follow-ups to sightings from staff and the public as well as incidental to extensive spotted owl surveys. Additional surveys are being conducted prior to implementation of the SERAL project to update locations and nesting status. There are four great gray owl sites in the SERAL project area, one occurs entirely on private land and so does not qualify as a National Forest System PAC. Another two occur primarily on private land but a portion of potential nest stand habitat is managed as PAC on National Forest System land. Only one PAC is entirely on National Forest System land.

Risk Factors

The Conservation Strategy for Great Gray Owl in California (Wu et al. 2016) summarized six risk factors potentially influencing great gray owl abundance and distribution:

1. *Livestock grazing* – Livestock grazing that substantially alters meadow hydrology and vegetation is likely one of the greater indirect threats to the great gray owl. Livestock grazing can remove cover for prey species, particularly voles (Beck and Winter 2000, Kalinowski et al. 2014).
2. *Timber harvest* - Timber harvest can present another threat to great gray owls by reducing canopy cover in potential or actual nesting areas or removing potential or actual nest structures, particularly if harvest tends to target the large trees that are most often essential for great gray owl nesting (Greene 1995, Beck and Winter 2000, Wu et al. 2016). When suitable nesting stands or trees are removed via clearcutting (even-age selection), habitat in that area is rendered unsuitable for great gray owl nesting. However, other harvest prescriptions (e.g., selective or uneven-age harvest) may not prove as detrimental to the owl. Wu et al. (2016) found eight of 55 great gray owl nests were located on private lands managed primarily for timber production, and in some cases, nests were adjacent to clearcut harvest units and within selective harvest units. Wu et al. (2016) also found 27 of 55 owls were on US Forest Service lands where varying degrees of timber harvest occurs. This suggests that carefully-managed timber harvest and the presence of great gray owls are not mutually exclusive.
3. *Human activity* – Types of human activities that are risk factors include noise and other disturbances, vehicle strikes, and rodenticide use.
4. *Wildfire* – The effects of fire on great gray owls are complex. Medium- and high-severity wildfire leads to loss of canopy cover and may consume nest trees but may also aid in the recruitment of snags that are suitable for nesting. Low-severity fires may help maintain grassy hunting patches by clearing out understory. Great gray owls are vulnerable to the loss of historical nest sites and other large trees near meadow edges that are suitable for nesting. Great gray owl conservation benefits by reducing the chances of losing stands of large trees adjacent to meadows in areas where similarly large trees may not be recruited for decades or even centuries. For example, seventy percent of 35 natural and artificial nest structures were consumed in the 2013 Rim Fire on the Stanislaus National Forest. Siegel et al. (2019) found that although post-fire habitat conditions appeared to not reduce occupancy rates, it could not be determined whether habitat conditions affected breeding status or nest success. Great gray owls have strong site fidelity; this trait could have compelled some to return to (or remain in) altered habitat after the fire, even if territories were no longer suitable for nesting or meeting other life-history needs (Siegel et al. 2019). Anecdotal data indicate successful nesting occurred at some of the mixed-severity burned sites after the fire, but not at some high-severity burned sites (NRIS).
5. *Drought and conifer mortality* - Prolonged drought and the interaction of drought-stressed trees with bark beetles and other agents of tree mortality can result in widespread conifer mortality. Conifer mortality on a large scale could degrade great gray owl nest stands and increase the likelihood of habitat loss from large, severe fires.
6. *Other* - predation and disease are other risk factors.

Risk factors 1 and 6 are beyond the scope of the SERAL project and Risk Factors 2, 3, 4, and 5 are synonymous with the four risk factors for California Spotted Owl (see CSO section for further discussion). The Conservation Strategy for Great Gray Owls in California (Wu et al. 2016) concludes that managing for forest resilience to the extent possible provides the best chance of conserving great gray owls into the future.

Indicators

The following indicators focus the effects analysis on risk factors that relate to project activities. Indicators are based on risk factors described in the best available scientific literature and form a basis for analyzing potential effects and determining how well project alternatives comply with management direction.

Indicator 1: Potential forest management activities within ¼ mile of PACs.

This indicator provides a measure to compare and contrast alternatives in relation to the risk factor of death, injury, or disturbance. Project activities that have the potential to cause death, injury, or disturbance include tree-falling with mechanized equipment and vehicle collisions with owls, especially adjacent to meadows (Bull and Duncan 2020, Keane et al. 2011, Wu et al. 2016).

Metric: Acres.

Indicator 2: Conditional flame length (CFL) > 8 feet within 1/4 mile of PACs.

This indicator provides a measure to compare and contrast alternatives in relation to the risk of high-severity wildfire to nest stands. Mechanical treatments are avoided within GGO PAC nest stands but surrounding fuel reduction treatments are expected to reduce the risk of high-severity stand-replacing fire to nest stands.

Conditional Flame Length (CFL) values are estimates modeled for each pixel, given the condition that a wildfire burns the pixel under different simulated wildfire conditions. A correlation exists between flame lengths and wildfire severity; high-severity (stand-replacing) fire risk is greatest when flame lengths exceed 8 feet, as these flame lengths are commonly associated with tree torching and crown fire initiation (Collins et al. 2013, Stephens et al. 2016).

Metric = acres.

Indicator 3: Improved SDI within ¼ mile of PACs. This indicator provides a measure to compare and contrast alternatives in relation to risk of large-scale drought and conifer mortality. Mechanical treatments are avoided within GGO PAC nest stands, but mechanical thinning treatments in adjacent stands for density management improve the Stand Density Index (SDI) in those stands. Improving the SDI in surrounding stands decreases the risk of overstory tree mortality to nest stands from “pathogen spillover” of bark beetles (Bulaon, B., Forest Pathologist, personal communication). SDI thresholds have been identified to indicate a forest’s susceptibly to mortality from drought, bark beetle attacks, and disease (Oliver and Uzoh 1997, Sherlock 2007). Vegetation adjacent to GGO nest stands in the SERAL project is primarily pine- or fir-dominated mixed conifer. A pine-dominated mixed conifer stand with an SDI value greater than 220, or a fir-dominated mixed conifer stand with an SDI value greater than 330 is indicative of significant inter-tree competition and stress, making the trees susceptible to mortality from drought, bark beetle attacks and disease (USDA Forest Service Region 5 2021). Post-treatment modeled estimates were calculated for acres where SDI is reduced to < 220 for pine-dominated stands or < 330 for fir-dominated stands from thinning treatments within ¼ mile of GGOW PACs.

Metric: Acres.

Indicator 4: Potential forest management treatment overlap with PACs. This indicator provides a measure to examine alternatives in relation to potential risks of modifying existing habitat conditions. While GGO nest stand habitat is avoided and not mechanically thinned (i.e., generally the 50 acres of forested habitat near the nest along meadow margins), alternatives may vary with regards to hand treatments, including handline construction, tree pruning, and cutting of small trees (less than 6 inches DBH) prior to burning as needed to protect important elements of owl habitat. This may apply to GGO PACs in the Wildland Urban Interface and/or GGO PACs where fire is prescribed. Additionally, under the action alternatives, encroaching conifers may be removed in meadow foraging habitat within PACs to maintain the meadows and enhance habitat needs of prey species.

Metric: Acres.

Management Direction

Current management direction for great gray owl for all action alternatives is from the Forest Plan (USDA Forest Service 2017). This direction includes designation of great gray owl PACs around all known nest stands. A PAC entails at least 50 acres of the highest quality nesting habitat (CWHR types 6, 5D, and 5M) that includes forest and meadow complexes. A limited operating period (LOP) that prohibits vegetation treatment and road construction is applied in a quarter mile buffer around an active nest from March 1 through August 15.

Great Gray Owl: Environmental Consequences

DIRECT AND INDIRECT EFFECTS

Table GGO1 compares the indicators across alternatives for great gray owl.

Table GGO1. Indicators by alternative for great gray owl.

Indicator	Metric	Alternative			
		1	2	3	4
Potential forest management activities that may occur within ¼ mile of PACs	Acres	890	0	851	825
Conditional flame length (CFL) > 8 feet within 1/4 mile of PACs	Acres	60	365	89	92
Improved SDI to target levels within ¼ mile of PAC [1]	Acres	473	0	433	408
Potential forest management treatment overlap with PACs (Rx fire [2])	Acres	79	0	79	79
Potential forest management treatment overlap with PACs (meadow maintenance[3])	Acres	13	0	13	13

[1] 1,241 total acres surrounding GGO PACs with SDI lowered to < 220 for pine dominated stands or <330 for fir dominated stands).

[2] Rx fire is prescribed fire only with hand treatments, including handline construction, tree pruning, and cutting of small trees (less than 6 inches DBH) prior to burning as needed to protect important elements of owl habitat. Hazard trees may be abated to protect life and property.

[3] meadow maintenance is the cutting and/or removal of encroaching conifers.

Indicator 1. There are between 825 and 890 acres of potential treatments within ¼ mile of GGO PACs across the action alternatives. However, the management requirement for a LOP within ¼ mile of active nests minimizes the probability that death, injury, or nesting disturbance would occur. Under no action, death, injury, or disturbance from active management would not be an issue because no active management would occur. However, under no action, the probability of high-severity fire would remain high, and so there is a much higher risk wildland fire could cause death, injury, or disturbance to great gray owls.

Indicator 2. All action alternatives significantly reduce eight foot flame length probabilities in areas surrounding GGO PACs with Alternative 1 performing best (22 percent reduction in Alternatives 3 and 4, and 24 percent reduction in Alternative 1). Under no action, about 1/3 of the area surrounding GGO PACs has conditional flame length probabilities >8 feet. Thus, under no action, a high long-term risk of nest stand loss to high-severity fire may be expected in GGO PAC nest stands.

Indicator 3. All action alternatives effectively reduce SDI across more than 33% of the area surrounding GGO PACs with Alternative 1 performing best. Under no action, SDI remains high (>220) across nearly 43% of the areas surrounding GGO PAC. Thus, under no action, overstory loss in GGO nest stands remains likely over the long-term.

Indicator 4. Under all action alternatives, expected forest treatment acres are the same. Forest treatments are limited in GGO PAC nest stands to hazard abatement for public safety, prescribed burning, and hand treatments -- including handline construction, tree pruning, and cutting of small trees (less than 6 inches DBH) prior to burning to protect important elements of owl habitat. Encroaching conifers may be removed in 13 acres of meadow to improve habitat for great gray owl prey. Expected acres of meadow habitat improvement are the same across action alternatives. However, DBH limits vary. For encroaching conifers in meadows, Alternatives 1 and 3 have a 40 inch DBH limit and Alternative 4 has a 30 inch DBH limit (DEIS Table S-2). Thus, Alternatives 1 and 3 would perform better in maintaining meadow habitat long-term as larger conifers serve as seed sources for conifer encroachment and have higher transpiration rates that may locally affect meadow hydrology and drying (Gross and Coppoletta 2013). Where nest stand habitat overlaps potential treatments (e.g., fuelbreaks), GIS and survey data indicate that sufficient habitat of equal quality exists in the vicinity such that the habitat may be re-mapped to avoid intersections with treatment areas. Additionally, where nest stand habitat cannot be avoided (e.g., hazard abatement), there is a requirement to consider alternatives to felling hazards in nest stands such as temporary road closure or nest structure creation by topping. Under no action, loss of meadow habitat to conifer encroachment may occur over the long-term.

CUMULATIVE EFFECTS

The US Forest Service queried its databases, State of California databases, and others (SERAL DEIS Appendix A) to determine present and reasonably foreseeable future actions as well as present and reasonably foreseeable future actions on other public (non-Forest Service) and private lands (SERAL DEIS Appendix A). Pertinent projects to consider for cumulative effects to great gray owl mainly involve timber management on private land in the SERAL project area. The great gray owl is specially managed as per the California Forest Practice Rules (Title 14, California Code of Regulations chapters 4, 4.5, and 10) which govern the regulation of timber harvesting on state and private lands in California. If it is determined that a proposed plan has the potential to harm owls directly or significantly disturb occupied nesting habitat, CDFW works with Cal Fire and the plan submitter to find alternatives and mitigation measures to prevent significant impacts to the species. Similarly, the USFS implements alternatives and mitigation measures to prevent significant impacts as per direction for Regional Forester Sensitive species as described above. Thus, significant cumulative effects are not expected to occur for this species in the SERAL project area.

Great Gray Owl: Determination

ALTERNATIVES 1, 3, and 4

The action alternatives, Alternative 1, 3, and 4, may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the great gray owl. This determination is based on the following rationale:

- LOPs are required and effectively reduce death, injury, and disturbance potential to an

insignificant level.
- The risk of habitat loss from high-severity fire or large-scale insect and drought related mortality would be significantly reduced because there is an effective risk reduction in forest stands surrounding GGO PACs with Alternative 1 performing best.
- Project activities in nesting habitat maintain nesting habitat and are limited to prescribed fire and/or hand treatments and hazard abatement needs that are very limited in scope, duration, and thus potential negative impact.
- While nesting habitat is maintained, foraging habitat is expected to be improved because encroaching conifers may be removed to maintain meadow habitat and prey populations.

ALTERNATIVE 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the great gray owl. This determination is based on the following rationale:

- No actions would occur to potentially impact this species or habitat. However, with no action to reduce fuels or SDI, high-severity fire and overstory mortality from insects, disease, and drought remains a risk to nesting habitat and may potentially contribute to a loss of viability long-term. Additionally, encroaching conifers would not be removed from meadow habitat and so foraging habitat may decline long-term.

Great Gray Owl: Compliance with Management Direction

THE ACTION ALTERNATIVES 1, 3, and 4 DEMONSTRATE FOREST PLAN COMPLIANCE THROUGH THE FOLLOWING

Alternatives 1, 3, and 4 maintain PACs and require LOPs as described in the Management Direction section.

California Spotted Owl: Affected Environment

Species and Habitat Account

Species

The California spotted owl (*Strix occidentalis occidentalis*) is currently managed as a USDA Forest Service Sensitive species (USDA Forest Service 2014a). Sensitive species are species identified by the Regional (R5) Forester where population viability is a concern because of 1) downward population trends and/or 2) diminished habitat capacity that may reduce species distribution. The current R5 guidance based on best available science for the California spotted owl (CSO) may be found in the California Spotted Owl Conservation Strategy (USDA Forest Service 2019). The California Spotted Owl Conservation Strategy (CSO CS) was developed to achieve three main goals for the California spotted owl across the species' range: (1) promote and maintain well-distributed owl habitat by developing key habitat elements and connectivity, (2) promote California spotted owl persistence by enhancing habitat resilience to multiple disturbances, including climate change, and (3) maintain a well-distributed and stable California spotted owl population by minimizing impacts from non-habitat threats. The Strategy's conservation approaches and measures are designed to achieve desired conservation outcomes for the California spotted owl. Desired conservation outcomes include 1) suitable habitat is well distributed and sufficient to support a sustainable owl population, 2) habitat is resilient to disturbances and climate change, considering NRV and recognizing that Sierra Nevada forests are dynamic ecosystems that will support a range of vegetation types and structures that vary over space and time, 3) California spotted owl populations are maintained or enhanced, and 4) California spotted owl habitat is transitioned to be more resilient, transitioned from the current situation towards NRV, and eventually towards the future range of variation. The Strategy is primarily based on the following sources:

- The California Spotted Owl: Current State of Knowledge [PSW-GTR-254 (Gutiérrez, et al. (technical editors) 2017)].
- United States Fish and Wildlife Conservation Objectives Report (U.S. Fish & Wildlife Service 2017).
- Natural Range of Variation for Yellow Pine Mixed-Conifer Forests in the Sierra Nevada, Southern Cascades, and Modoc and Inyo National Forests [PSW-GTR-256 (Safford and Stevens 2017)].
- Emerging new published science and local expertise.

The California spotted owl occurs from the southern Cascades, throughout the Sierra Nevada in California and into Nevada, mountainous regions of southern California and the central Coast Ranges up to Monterey County (USDA Forest Service 2004). The CSO inhabits elevations ranging from 1,000 to 7,740 feet in the Sierra and 86 percent of owls occur between 3,000 and 7,000 feet (Gutiérrez et al. 2020, Verner et al. 1992). On the west slope of the Sierra Nevada, the CSO uses a wide range of habitat types and is considered a year-round resident, although some birds may facultatively migrate downslope in the winter (Gutiérrez et al. 2020, Verner et al. 1992).

The project area is located well within the current distributional range of spotted owls across the Sierra Nevada Bioregion and may be described as being in the heart of CSO range in the Sierra Nevada (Figure CSO 1).

Figure CSO 1. SERAL project area in relation to the range of California Spotted Owl in the Sierra Nevada (USDA Forest Service 2019).

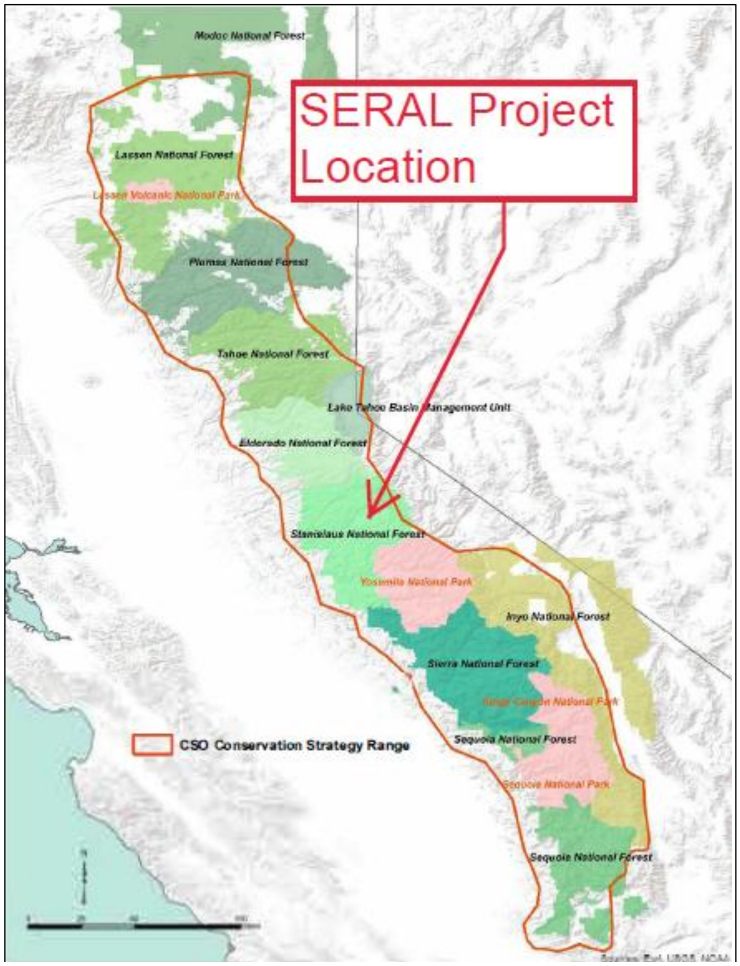


Figure CSO 1. SERAL project area in relation to the range of California Spotted Owl in the Sierra Nevada (USDA Forest Service 2019).

The project area is also located partially in and between Areas of Concern 5 and 6 for CSO (Figure CSO 2). Areas of concern were identified in the California Spotted Owl Technical Report (Verner et al. 1992) and were defined as areas within the range of California Spotted Owl where potential gaps in habitat and the associated loss of forest connectivity are a potential issue. Areas of Concern represent areas where management decisions may have a disproportionate potential to affect the California spotted owl population.

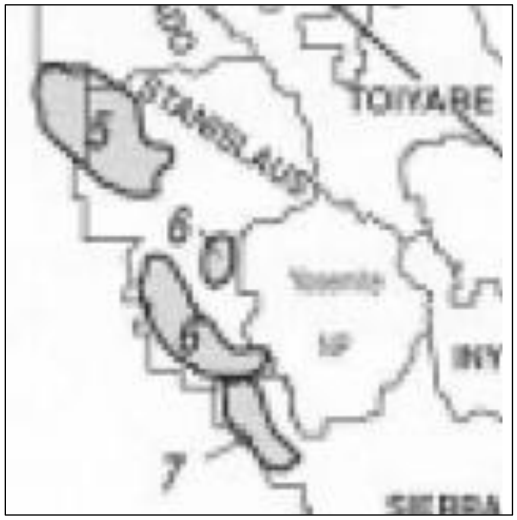


Figure CSO 2. Areas of Concern from Verner et al. 1992, p. 47.

The geographical location of the SERAL project area takes on even more importance when recent large, high-severity fires are also considered (Figure CSO 3). Recent examples of wildfires with large, high-severity areas overlapping CSO habitat are the 2014 King Fire (100,000 acres), the 2020 Creek Fire (380,000 acres), the 2020 North Complex Fire (319,000 acres), and the 2020 Sequoia National Forest Complex Fire (174,000 acres). Locally bordering the SERAL project area was the 2013 Rim Fire (250,000 acres) to the southeast and the 2018 Donnell Fire (36,000 acres) to the northeast. In 2021, the Tamarack Fire (68,637 acres) and the Caldor Fire (255,000 acres) occurred to the north; the Windy (97,554 acres) and KNP Complex (88,307 acres) fires to the south (Figure CSO 3). Each of these fires on their own has negatively impacted several CSO sites (Rojas 2021, NRIS Wildlife GIS data and survey results). When taken as a whole, the number of CSO sites impacted by high-severity fire is of species conservation concern to owl research scientists (USDA Forest Service 2019, Jones et al. 2016a, 2016b, 2019, 2020a, and 2021). **It is now apparent that the SERAL project area location is one of the largest remaining areas of mature forest habitat in the Sierra Nevada that has not burned in a large high-severity fire.** Thus, CSO sites in the SERAL project area location are of particular importance to the distribution of California spotted owl in the Sierra Nevada and potentially key to this subspecies' continued persistence, especially considering current projections for climate change (Jones et al. 2016a, 2021). This is a major reason why the adoption of the CSO Strategy and the SERAL project area were selected by the Yosemite Stanislaus Solutions (YSS) Collaborative Group in consultation with the Forest Service. The urgency of fire risk to this area is further emphasized by the project area being listed as the top priority for Region 5 in the fireshed registry (Ager et al. 2021).

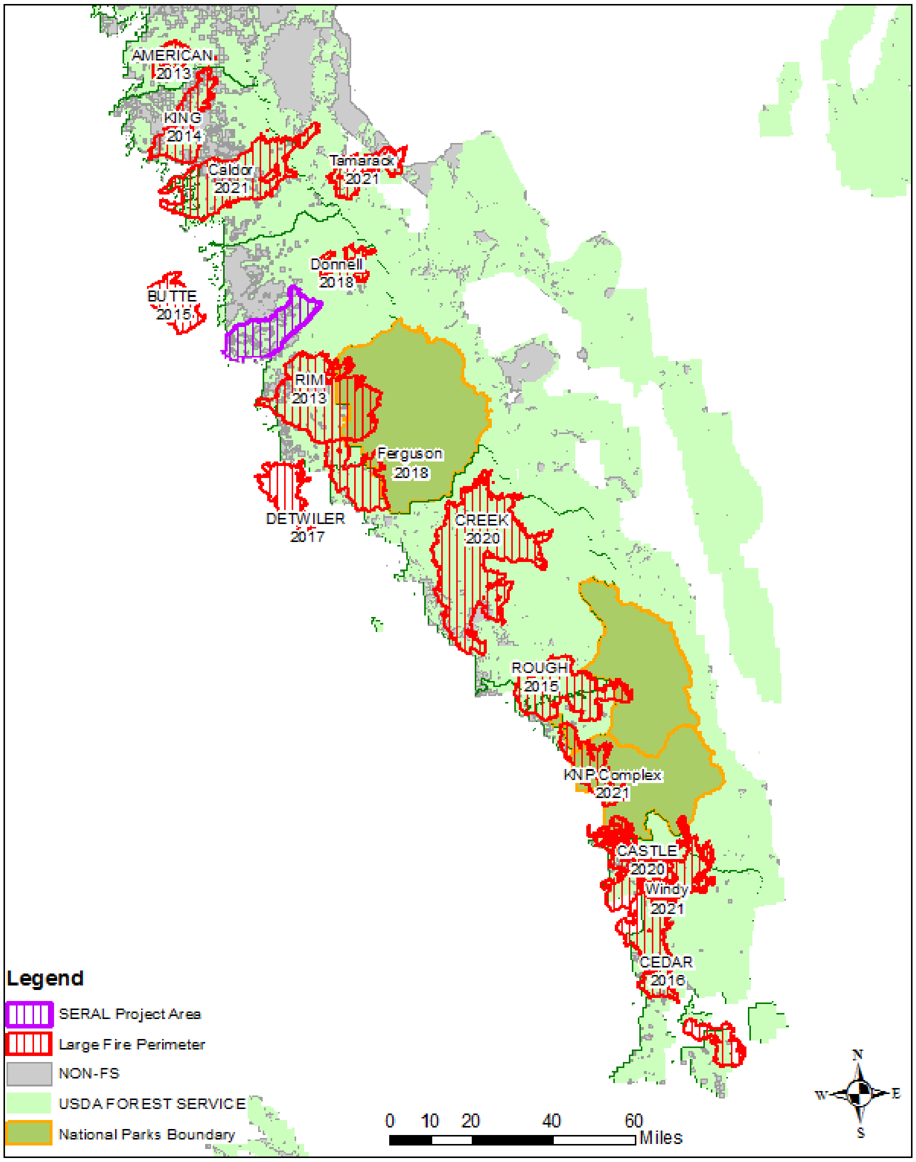


Figure CSO 3. The SERAL project area in relation to large, high-severity fire from 2013 to present.

California spotted owl sites are identified using well established protocol surveys (USDA Forest Service 1991b). Protocol surveys have been conducted throughout the project area for the past three decades. These surveys are best described as opportunistic depending upon planned activities and funding levels but have occurred with a frequency and geographic extent such that inventory information for the analysis area is considered essentially complete (CDFW 2021b, NRIS Wildlife Database). As per protocol, current surveys are required and have been scheduled prior to implementation. Survey information is primarily used to determine site occupancy for restoration prioritization, and to identify territories, nest stands, nest trees, roost sites, and owl locations generally (USDA Forest Service 1991b, USDA Forest Service 2019, Wood et al. 2018). Surveys are also used to determine the need for Limited Operating Periods (LOPs) during implementation and to better delineate PACs (USDA Forest Service 2019). LOPs are seasonal restrictions on potentially disturbing activities from March 1 through August 15 (USDA Forest Service 2019). PACs are the primary area a pair uses for nesting and roosting (Berigan et al. 2012, Verner et al. 1992), are 300 acres in size, and are established on National Forest System (NFS) lands (USDA Forest

Service 2000, USDA Forest Service 2019, Verner et al. 1992). PACs are only less than 300 acres in size if bordering non-NFS lands and < 300 acres of NFS lands are available. Under the CSO Strategy (Alternative 1), territories are defined as the area defended by a resident pair of owls from other owls of the same species (Bingham and Noon 1997, Blakesley et al. 2005, Gutiérrez et al. 2020) and are 1,000 acres in size (Tempel et al. 2016, USDA Forest Service 2019). The territory includes the associated 300 acre PAC, generally imbedded within the territory (USDA Forest Service 2019). Territories are mapped as a circular core around an activity center, however, territory boundaries may be adjusted to be noncircular, as needed, to include the most sustainable areas of high-quality habitat and exclude areas less likely to support suitable habitat (Ibid.). Under the Sierra Nevada Forest Plan Amendment (USDA Forest Service 2004), Home Range Core Areas (HRCAs) are delineated (Alternatives 3 and 4). HRCAs encompass the best available nesting and roosting habitat in the closest proximity to the owl activity center within 1.5 miles of the activity center. HRCAs are 1,000 acres in size and include the associated 300 acre PAC (Ibid.). Territories (Alternative 1) may overlap one other and HRCAs (Alternatives 3 and 4) may overlap one another.

Survey results indicate that the SERAL project area is at or near carrying capacity for CSO where carrying capacity is the maximum number of animals that can be sustained over the long-term on a specified land area (Verner et al. 1992). A gap analysis indicates potential space for only two to four additional CSO sites in the SERAL project boundary (Figure CSO 4). Gap areas will be included in protocol surveys prior to implementation to identify any unknown territories. Currently, there are 53 CSO PACs overlapping the project area totaling 15,722 acres and 57 CSO territories totaling 47,958 acres that overlap with the project area (Figure CSO 4). This represents about 1/3 of the CSO sites on the Stanislaus National Forest and about 5% of historical (i.e., prior to recent fire seasons) CSO sites in the Sierra Nevada. Overall, CSO PAC acres currently comprise 17 percent of National Forest System land in the project area and CSO Territory acres comprise 40 percent of the project area across all ownerships. Of the 53 CSO PACs in the project area, survey data indicate that 36 sites have reproductive status, 13 have pair status, and 4 have territorial single status. PACs with territorial single status are eligible to be "retired" after adequate surveys have been completed as per the CSO Conservation Strategy to be adopted under Alternative 1. Under the 2004 SNFPA (Alternatives 3 and 4), PACs are static designations that limit the application of ecological principles in dynamic systems. In contrast, the CSO Strategy emphasizes PAC management that continually improves the effectiveness and dynamic nature of the PAC network. This includes providing an opportunity to retire PACs based on occupancy history and survey effort. The intent is for retired PACs to undergo restoration to make habitat more resilient and available for future owl use. Thus, selective PAC retirement is important to landscape-level ecological processes and restoration. These measures provide for reevaluation and retirement of long-vacant PACs, PACs that were mistakenly established for non-territorial owls, and/or PACs that may have contributed to the CSO population in the past, but no longer do so. The CSO Strategy does not recommend retiring PACs that are known to have been recently occupied by territorial pairs or are of especially high reproductive value. In the SERAL project area, as only four CSO PACs are even eligible for retirement based on current status, and because current survey work may determine the PACs are indeed occupied by pairs, and because we expect that current survey work may discover 2 to 4 CSO pairs in "gap" areas, we expect the actual number of CSO PACs known in the SERAL project area to remain unchanged or only vary by 1 or 2 territories. We note that the establishment of new PACs, and the retirement of invalid PACs will help achieve the eventual goal for CSO nest/roost habitat to be in more suitable and ecologically sustainable locations (USDA Forest Service 2019).

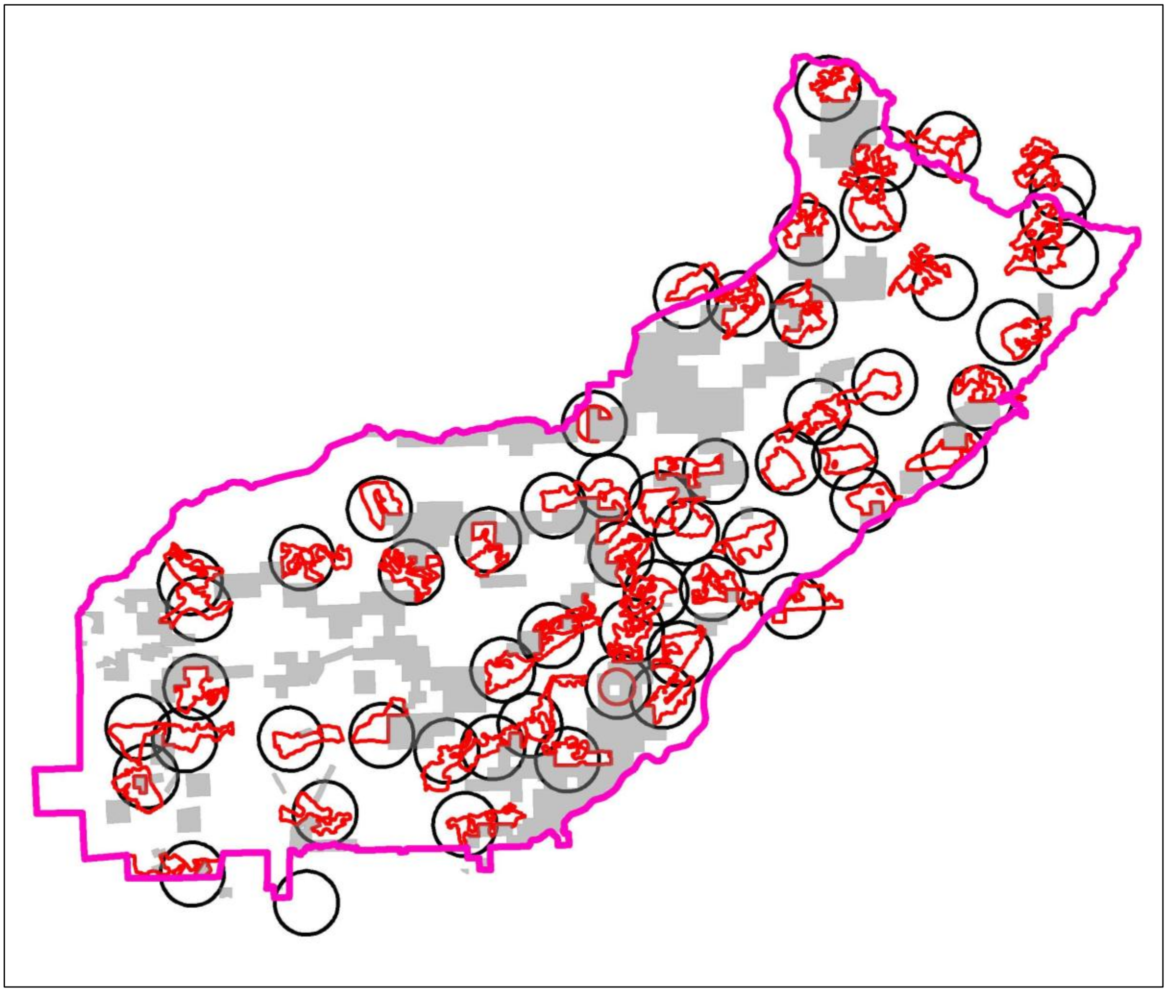


Figure CSO 4. Distribution of CSO PACs (red) and Territories (black circles) in the SERAL project area (magenta) in relation to private land (gray).

Habitat

The CSO Strategy (USDA Forest Service 2019) summarizes the best available science on CSO habitat and is incorporated below for reference:

Fire exclusion over the last century has resulted in an estimated 2.9 million acres of 'backlogged' forest in need of treatment to reduce the risk of high-severity fire (North et al. 2012). Today's disrupted fire regimes in the Sierra Nevada include lower amounts of low- and moderate-severity fire and more large, high-severity patches of stand-replacing fires that destroy large blocks of important CSO habitat. Natural fires burning within the NRV in CSO habitat in the Sierra Nevada are burning 85 percent less frequently than historically. The current average fire size (excluding those immediately put out) is 5 times greater, and high-severity fire is burning 5 to 7 times more area than under pre-suppression conditions (Safford and Stevens 2017, page 180). Historic fire regimes would have resulted in about half of all forested area to reach late succession, providing substantial suitable habitat for the CSO (Miller and Safford 2017). Given CSOs use mixed-severity fire areas dominated by low and moderate severity and generally avoid larger areas of high severity, the historic fire regime was likely beneficial to the species (Eyes et al. 2017, Jones et al. 2016b, Lee et al. 2012 and 2013, Roberts et al. 2011, Rockweit et al. 2017).

Suitable CSO habitat, as defined in the Strategy, consists of both high-quality nesting and roosting habitat and sufficient habitat diversity/heterogeneity to provide for foraging. Preferred prey items of CSO are wood rats (*Neotoma macrotis*) and flying squirrels (*Glaucomys sabrinus*); habitat heterogeneity promotes the availability of these prey items (USDA Forest Service 2019). The highest quality nesting and roosting habitat for the CSO consists of areas with large/tall trees (more than 24 inches, but preferably more than 30 inches quadratic mean diameter) and moderate to high canopy cover (more than 40 percent cover). Suitable nest/roost/forage habitat also includes areas with medium-sized trees (11 to 24 inches quadratic mean diameter) and moderate to high canopy cover. The quadratic mean diameter, or QMD, is the diameter at breast height of a tree of mean basal area.

CSO demographic parameters (that is, occupancy, reproduction, and survival) have been correlated with CSO habitat quality and availability at various spatial scales (Blakesley et al. 2005). A detailed synthesis of the research can be found in PSW-GTR-254, Chapter 3 (Roberts 2017). From the 1990s to 2013 in the Sierra Nevada, CSO populations declined within the demography study areas on national forests: Sierra (31 percent), Lassen (44 percent), and Eldorado (50 percent) (Conner et al. 2016, Tempel et al. 2014b). Reproduction appears to be relatively constant in all study areas in the Sierra Nevada except the Eldorado, where measured parameters continue to be highly variable between years (Blakesley et al. 2010). The Sequoia-Kings Canyon National Park (SEKI) population appears to be stable or increasing over the same period. Differences in population trends between the national forests and the national parks could be related to a variety of factors including past forest management strategies (Blakesley et al. 2005, Seamans and Gutiérrez 2007, Tempel et al. 2014a). For example, the disparity may be related to SEKIs recent extensive and growing use of fire for ecological restoration, while general fire suppression has continued on National Forest System lands (Kilgore and Taylor 1979, van Wagtendonk 2007). The most recent scientific analysis indicates current population declines in the study areas on National Forest System lands are likely not the result of current forest management strategies but are instead likely a lag effect from historic large tree removal and a century of fire suppression (Jones et al. 2017). Continued fire suppression and other activities that maintain or increase forest homogeneity are likely contributing to these declines (Ibid.).

The majority of past CSO research focuses on the relationship between CSO occupancy and the percentage of canopy cover at the territory scale. Medium (40 to 70 percent) and high (more than 70 percent) canopy cover have been positively related to CSO occupancy, survival, and productivity (Tempel et al. 2016). Ongoing research suggests CSOs select against areas of low canopy cover (less than 40 percent) within 10 acres (4 hectares) of nest sites, yet CSOs are tolerant of sparsely distributed low-canopy-cover areas in the 300 acres surrounding activity centers (“protected activity centers”) and beyond (North et al. 2017a).

An important predictor of occupancy appears to be the presence of large/tall tree-dominated patches of habitat within a backdrop of generally dense canopy cover (Jones et al. 2017, North et al. 2017a). CSOs select for tall tree cover (more than 160 feet) and against short tree cover (less than 53 feet). North et al. (2017a) suggest density of large/tall trees is likely the most important attribute for suitable owl nesting habitat, rather than the amount of canopy cover. The large-tree category in most studies cannot differentiate between large and very large trees, as the category often includes all quadratic mean diameters (QMDs) more than 24 inches. However, correlations between diameter breast height (DBH) and tree height suggest areas of QMD greater than 30 inches are likely most important. Recent work using more fine-scale vegetation information showed owl selection for larger tree, high canopy cover habitat and selection against small and medium tree, high canopy habitat at higher elevation sites (more than 4,250 feet), and no selection preference at lower elevations. North et al. (2017a) found both nest sites and protected activity centers (PACs) were dominated by tall tree and codominant structure classes, which generally coincided with more than 55 percent canopy cover, but territories and surrounding landscapes had much more diverse distributions of structure and cover classes. Gaps or openings of any size were rare in nest stands (approximately 10 acres surrounding the nest), but gaps in the PACs and territories were more consistent with the surrounding landscapes (North et al. 2017a).

For foraging, some studies suggest CSOs tend to select edge habitat (Eyes 2014, Eyes et al. 2017, Roberts 2017, Williams et al. 2011). Owls appear to benefit from mature forests with a mosaic of vegetation types and seral stages that promote higher prey diversity and abundance by increasing habitat diversity in foraging areas (Franklin et al. 2000, Hobart et al. 2019a, 2019b, and 2021, Tempel et al. 2014, Ward et al. 1998, Zabel et al. 1995). Small open areas, areas of low canopy cover (less than 40 percent), and edges interspersed with high-quality habitat are considered important for owl foraging and habitat diversity.

While multiple data sources exist to define habitat suitability and quality, conservation measures in the CSO Strategy currently reference the California Wildlife Habitat Relationships (CWHR) system (Mayer and Laudenslayer 1988). CWHR is currently the only dataset consistently available across the CSO range. The CSO Strategy uses CWHR definitions of suitable habitat to provide a metric for both nesting/roosting and foraging habitat (Mayer and Laundenslayer 1988). The CWHR system integrates the tree size class, canopy cover class, and dominant forest type into a CWHR type that is assigned a low, medium, or high value for owl nesting suitability. The system also assigns a CWHR value for foraging suitability. Application of various remotely sensed data such as LiDAR (Light Detection and Ranging), when available as it was for this project area, enable higher resolution and more accurate capture of forest structure characteristics that are important to the CSO such as the presence of small patches of very large trees or large snags (North and Manley 2012, North et al. 2017a).

The CSO Strategy uses CWHR definitions of suitable habitat to provide a metric for both nesting/roosting and foraging habitat (Mayer and Laundenslayer 1988). CWHR habitat types for CSO include Douglas fir (DFR), eastside pine (EPN), Jeffrey pine (JPN), lodgepole pine (LPN) montane hardwood-conifer (MHC), montane hardwood (MHW), montane riparian (MRI), ponderosa pine (PPN), red fir (RFR), Sierran mixed conifer (SMC), and white fir (WFR). The CWHR system (Mayer and Laudenslayer 1988) uses tree size and cover as classification categories (Table CSO1).

Table CSO1. CWHR classification system.

CWHR Classification	Tree Size QMD	CWHR Canopy Class	Canopy Cover
4D	11 to 24”	Dense cover	60 to 100 percent
4M	11 to 24”	Moderate cover	40 to 59 percent
5D	more than 24”	Dense cover	60 to 100 percent
5M	more than 24”	Moderate cover	40 to 59 percent
6		Multilayered canopy with dense cover	

For the purposes of SERAL, WHR size and density as well as canopy cover, were modeled using the F3 framework (Huang et. al 2018). F3 extrapolates the details of forest inventory plots (FIA) and individual-tree model outputs to a spatially-contiguous landscape by fusing tree-list field measurements, individual tree growth and yield models, remote sensing including LiDar, and environmental geospatial datasets.

Using these imputed size, density, and canopy cover metrics, suitable habitat for CSO nesting and roosting were classified into two general categories: 1) highest quality habitat and 2) best available habitat (Table CSO2).

Table CSO2. Categories of CSO habitat.

Suitable Habitat Categories	CWHR Classification	Tree Size	Canopy Cover

Highest Quality	5D, 5M, 6	More than 24-inches	50 to 100 Percent
Best Available	4D, 4M	11 to 24 inches	40 to 100 Percent

Existing conditions for PACs, Territories, HRCAs, watersheds, and project (multiple watersheds) by CWHR type are provided in Tables below:

PACs

Desired conservation outcomes for PACs are to include 300 acres of the highest quality nesting and roosting habitat, in as compact an area as possible, comprised of (1) CWHR classes 6, 5D, 5M, 4D, and 4M (listed in descending order of priority); (2) at least two tree canopy layers; (3) dominant and codominant trees averaging more than 24 inches DBH; (4) more than 60 to 70 percent canopy cover; (5) large snags (at least 45 inches DBH); and (6) snag and down woody material levels that are higher than average.

Currently more than ¾ of CSO PACs in the SERAL project area have less than half of the PAC comprised of highest quality nesting and roosting habitat of CWHR 6, 5D, 5M (Table CSO3). Approximately half of the CSO PACs largely lack high quality nesting and roosting habitat (i.e., <5% of the PAC currently has CWHR 6, 5D, 5M patches). This indicates an opportunity/need to develop higher quality habitat in PACs by selectively managing portions of PAC that currently contain lower quality habitat that is also more fire and disturbance prone (USDA Forest Service 2019). Overall, more than half of the habitat in PACs consists of dense, disturbance-prone stands (CWHR 4D and 4M).

Table CSO3. Percent of suitable CWHR types by PAC.

	%CWHR				
PAC ID	**4M**	**4D**	**5M**	**5D/6**	**Total 5/6**
TUO0005 – Cow Cr Upper	24%	0%	71%	0%	71%
TUO0006 – Strawberry	2%	0%	95%	2%	97%
TUO0014 – Lily Cr D53	6%	0%	94%	0%	94%
TUO0015 – B. Afterbay	44%	32%	24%	0%	24%
TUO0017 – Hart Cr	44%	13%	42%	1%	43%
TUO0018 – Bumblebee	18%	0%	70%	10%	81%
TUO0037 – Dry Meadows	40%	19%	7%	32%	39%
TUO0038 – Smoothwire	8%	74%	0%	17%	17%
TUO0041 – Grant Ridge	53%	40%	0%	0%	0%
TUO0048 – Beardsley N	75%	16%	7%	0%	7%
TUO0049 – Eagle Cr Camp	7%	91%	0%	0%	0%
TUO0050 – Indian Spring	23%	0%	1%	0%	1%
TUO0051 – Schoettgun Pass	27%	4%	32%	5%	36%
TUO0052 – Crandall	19%	49%	5%	27%	32%
TUO0055 – Lower Deer Cr	21%	73%	0%	0%	0%
TUO0056 – Lyons Dam	44%	31%	19%	3%	22%
TUO0058 – Mile 23	21%	77%	0%	0%	0%
TUO0093 – Schaeffer M	9%	16%	0%	0%	0%

TUO0094 – MF Stanislaus II	28%	56%	0%	0%	0%
TUO0102 – Campoodle Cr U	95%	0%	3%	0%	3%
TUO0105 – French Camp	3%	11%	0%	0%	0%
TUO0106 – Contention Rdg	3%	63%	0%	0%	0%
TUO0107 – Mid Rose Cr	7%	70%	0%	0%	0%
TUO0108 – Dry Cr	0%	99%	0%	0%	0%
TUO0109 – Deer Cr West	5%	94%	0%	0%	0%
TUO0110 – N Stony Gulch	0%	95%	0%	0%	0%
TUO0114 – Fivemile Cr	0%	62%	0%	0%	0%
TUO0117 – Strawberry N	66%	0%	21%	0%	21%
TUO0121 – Sand Bar Flat	18%	62%	0%	0%	0%
TUO0136 – Contention Mine	11%	52%	0%	0%	0%
TUO0137 – D51 Girl Mine	0%	99%	0%	0%	0%
TUO0139 – Cedar Ridge	2%	98%	0%	0%	0%
TUO0152 – Upper S Fork	19%	0%	79%	1%	80%
TUO0153 – W Bald Mtn	59%	6%	31%	2%	33%
TUO0154 – Lower S Fork	41%	40%	5%	13%	18%
TUO0160 – Brushy Hollow	64%	0%	8%	26%	34%
TUO0163 – Rushing M	30%	9%	0%	0%	0%
TUO0168 – 65% slope	0%	100%	0%	0%	0%
TUO0170 – Cow Cr Lower	32%	22%	4%	0%	4%
TUO0171 – Pedro Flat	34%	52%	5%	9%	14%
TUO0172 – Fraser Flat	4%	0%	96%	0%	96%
TUO0189 – Stanislaus Tun	2%	90%	0%	0%	0%
TUO0190 – Lower Tunnel Cr	17%	83%	0%	0%	0%
TUO0202 – Upper Knight Cr	3%	96%	0%	0%	0%
TUO0203 – Ruby	41%	56%	1%	1%	2%
TUO0207 – Upper Tunnel Cr	31%	65%	1%	3%	4%
TUO0208 – Upper Deer Cr	23%	76%	0%	0%	0%
TUO0209 – Spring Gap	28%	22%	0%	50%	50%
TUO0216 – Mile 16	82%	8%	8%	0%	8%
TUO0220 – Campoodle Cr L	31%	1%	31%	36%	67%
TUO0221 – Horseman Trail	4%	90%	3%	4%	7%
TUO0222 – Mile 22	41%	55%	0%	0%	0%
TUO0223 – Lyons Cr	39%	23%	3%	26%	30%
Average	**42%**	**15%**	**5%**	**20%**	**25%**

Departure from reference conditions may result in predicted vegetation burn severity far outside of the Natural Range of Variation (NRV) and subsequent habitat loss. The Northern California Fire Severity Prediction System (NCFS) models fire severity probabilities (Drury 2021; https://www.fs.fed.us/psw/programs/ff/staff/sdrury/; Taylor et al. 2021). NFCS is a sophisticated model that uses the latest best available science to produce spatially explicit fire severity prediction maps if a fire were to start during 90th percentile fire weather conditions (typical for late afternoons late July through early September). Additional details may be found in the DEIS.

Predicted vegetation burn severity was modeled across the landscape for each PAC (Table CSO4). This model indicates that 90% of PACs in the SERAL project would experience more than 75% basal area mortality over more than 50% of the PAC given a fire start on a typical summer day. That amount of basal area loss makes it highly unlikely that occupancy and productivity could be sustained in those PACs long-term (Jones et al. 2021). The remaining sites largely have a brush component such that the basal area loss in trees may be relatively low, but the vegetation burn severity in brushy uplands may still be high. Overall, the model indicates few PACs would be viable were a large wildland fire to occur in the SERAL project area under 90th percentile fire weather.

Table CSO4. Percent potential fire severity level within CSO PACs (Northern California Fire Severity prediction system). The 90th percentile fire weather is used to model late summer afternoons, typical of late July through early September and fire severity in this model is related to basal area loss in trees.

	Probable proportion of PAC area by fire severity under 90th percentile fire weather percentile conditions		
PAC ID	**Low**	**Moderate**	**High**
TUO0005 – Cow Cr Upper	0%	43%	57%
TUO0006 – Strawberry	0%	48%	52%
TUO0014 – Lily Cr D53	0%	28%	72%
TUO0015 – B. Afterbay	0%	13%	87%
TUO0017 – Hart Cr	0%	22%	78%
TUO0018 – Bumblebee	0%	26%	74%
TUO0037 – Dry Meadows	0%	9%	90%
TUO0038 – Smoothwire	0%	2%	98%
TUO0041 – Grant Ridge	0%	7%	92%
TUO0048 – Beardsley N	0%	16%	84%
TUO0049 – Eagle Cr Camp	0%	6%	94%
TUO0050 – Indian Spring	4%	78%	18%
TUO0051 – Schoettgun Pass	4%	41%	56%
TUO0052 – Crandall	0%	2%	97%
TUO0055 – Lower Deer Cr	1%	21%	78%
TUO0056 – Lyons Dam	1%	13%	86%
TUO0058 – Mile 23	0%	4%	96%
TUO0093 – Schaeffer M	6%	72%	22%
TUO0094 – MF Stanislaus II	6%	36%	58%
TUO0102 – Campoodle Cr U	0%	19%	81%
TUO0105 – French Camp	23%	1%	76%
TUO0106 – Contention Rdg	61%	2%	37%
TUO0107 – Mid Rose Cr	50%	6%	45%
TUO0108 – Dry Cr	8%	2%	90%
TUO0109 – Deer Cr West	10%	1%	89%
TUO0110 – N Stony Gulch	1%	2%	97%
TUO0114 – Fivemile Cr	10%	19%	70%
TUO0117 – Strawberry N	0%	35%	65%
TUO0121 – Sand Bar Flat	4%	11%	86%
TUO0136 – Contention Mine	3%	11%	87%
TUO0137 – D51 Girl Mine	30%	1%	69%

TUO0139 – Cedar Ridge	5%	1%	94%
TUO0152 – Upper S Fork	1%	20%	79%
TUO0153 – W Bald Mtn	1%	9%	90%
TUO0154 – Lower S Fork	0%	10%	90%
TUO0160 – Brushy Hollow	0%	3%	97%
TUO0163 – Rushing M	30%	25%	46%
TUO0168 – 65% slope	12%	17%	71%
TUO0170 – Cow Cr Lower	13%	39%	48%
TUO0171 – Pedro Flat	0%	7%	93%
TUO0172 – Fraser Flat	0%	28%	72%
TUO0189 – Stanislaus Tunnel	32%	7%	61%
TUO0190 – Lower Tunnel Cr	12%	15%	73%
TUO0202 – Upper Knight Cr	3%	1%	97%
TUO0203 – Ruby	0%	2%	98%
TUO0207 – Upper Tunnel Cr	0%	1%	99%
TUO0208 – Upper Deer Cr	0%	12%	88%
TUO0209 – Spring Gap	0%	0%	100%
TUO0216 – Mile 16	0%	6%	94%
TUO0220 – Campoodle Cr L	0%	11%	89%
TUO0221 – Horseman Trail	22%	7%	71%
TUO0222 – Mile 22	0%	8%	91%
TUO0223 – Lyons Cr	0%	12%	88%
Overall (53)	**6%**	**16%**	**77%**

Territory (applies only to Alternative 1)

Desired conservation outcomes for an occupied territory are to maintain and promote 40 to 60 percent of a territory in mature tree size classes with moderate and high canopy cover to provide a mosaic of nesting, roosting, and foraging conditions (USDA Forest Service 2019). This corresponds to roughly the following CWHR size/density classes, again in descending order of priority: 6, 5D, 5M, 4D, and 4M. Those territories in more mesic conditions and at higher elevations within the watershed should contain relatively more of this habitat than those in drier conditions and at lower elevations (Ibid). The remainder of the territory should represent a diversity of many different structure and canopy cover classes that will provide appropriate foraging conditions. When occupied territories do not meet the desired conditions described above, the existing large tree moderate/high canopy cover habitat (for example, CWHR 6, 5D, 5M) is retained wherever it exists throughout the territory.

Currently the majority of existing territories within the SERAL area provide 40 to 60 percent of a territory in mature tree size classes with moderate and high canopy cover for nesting, roosting, and foraging, corresponding to the following CWHR size/density classes in descending order of priority: 6, 5D, 5M, 4D, and 4M. Territories at low elevations, dry aspects, and/or of riparian-hardwood habitat type tend to contain closer to 40% of this habitat type and territories in more mesic conditions and at higher elevations closer to 60%. However, the majority of the habitat in CSO Territories is composed of lower size class habitat – smaller trees in very high densities (CWHR 4). Smaller trees in very high densities, a result of prior logging activities and long-term fire suppression, are vulnerable to disturbances such as wildfire, insect, and disease outbreaks, which may result in slower succession into the highest-quality habitat

(USDA Forest Service 2019, Jones et al. 2021). Overall, treatment options to increase resiliency and move conditions toward NRV appear largely available but to varying degrees in each territory (Table CSO5).

Table CSO5. CSO Territory by nest stand elevation, aspect, habitat type, and percent CWHR within Territory. Habitat type is either conifer (CON) or foothill riparian/hardwood (R-H) following Verner et al. 1992.

			%CWHR					
Territory ID	**Elevation / aspect**	**Type**	**4M**	**4D**	**5M**	**5D/6**	**Total 5/6**	**Total all**
TUO0004- Cascade Cr L	6,529 W	CON	18%	0%	34%	0%	34%	52%
TUO0005 – Cow Cr Upper	6,462 NW	CON	13%	1%	82%	0%	82%	95%
TUO0006 – Strawberry	5,429 W	CON	22%	0%	55%	2%	58%	79%
TUO0014 – Lily Cr D53	6,746 W	CON	16%	1%	69%	0%	69%	86%
TUO0015 – B. Afterbay	3,510 SW	CON	39%	28%	12%	1%	12%	79%
TUO0017 – Hart Cr	3,918 W	CON	46%	25%	19%	2%	21%	92%
TUO0018 – Bumblebee	5,968 W	CON	36%	1%	47%	4%	51%	88%
TUO0037 – Dry Meadows	5,584 S	CON	43%	17%	2%	14%	17%	77%
TUO0038 – Smoothwire	5,122 S	CON	31%	29%	3%	17%	20%	79%
TUO0041 – Grant Ridge	4,335 SW	CON	25%	29%	0%	0%	0%	54%
TUO0048 – Beardsley N	5,021 S	CON	48%	17%	3%	1%	3%	69%
TUO0049 – Eagle Cr Camp	4,733 SE	CON	12%	46%	0%	0%	0%	58%
TUO0050 – Indian Spring	4,031 NW	CON	35%	2%	0%	0%	0%	37%
TUO0051 – Schoettgun Pass	3,306 SW	CON	24%	29%	1%	2%	3%	56%
TUO0052 – Crandall	4,417 SE	CON	17%	59%	3%	14%	17%	93%
TUO0055 – Lower Deer Cr	3,757 SW	CON	27%	37%	0%	0%	0%	64%
TUO0056 – Lyons Dam	3,935 W	CON	39%	26%	9%	13%	23%	88%
TUO0058 – Mile 23	4,555 E	CON	37%	32%	7%	1%	8%	78%

TUO0093 – Schaeffer M	3,117 SW	CON	24%	22%	0%	0%	0%	46%
TUO0094 – MF Stanislaus II	3,814 SW	CON	18%	57%	0%	0%	0%	75%
TUO0102 – Campoodle Cr U	6,339 E	CON	58%	0%	4%	5%	9%	67%
TUO0105 – French Camp	2,353 SE	R-H	3%	31%	0%	0%	0%	34%
TUO0106 – Contention Rdg	1,562 SE	R-H	7%	50%	0%	0%	0%	57%
TUO0107 – Mid Rose Cr	2,203 S	R-H	11%	43%	0%	0%	0%	54%
TUO0108 – Dry Cr	3,389 E	CON	32%	49%	0%	0%	0%	80%
TUO0109 – Deer Cr West	3,597 S	CON	30%	51%	0%	0%	0%	80%
TUO0110 – N Stony Gulch	3,404 S	CON	11%	66%	0%	0%	0%	77%
TUO0114 – Five mile Cr	3,107 W	R-H	0%	36%	0%	0%	0%	36%
TUO0117 – Strawberry N	5,608 S	CON	50%	0%	15%	0%	15%	64%
TUO0121 – Sand Bar Flat	4,474 SE	CON	37%	29%	0%	0%	0%	66%
TUO0136 – Contention Mine	2,917 S	R-H	8%	42%	0%	0%	0%	51%
TUO0137 – D51 Girl Mine	2,258 S	R-H	6%	58%	0%	0%	0%	64%
TUO0139 – Cedar Ridge	3,493 SW	CON	15%	80%	0%	0%	0%	95%
TUO0152 – Upper S Fork	4,672 SW	CON	46%	10%	32%	0%	32%	88%
TUO0153 – W Bald Mtn	4,707 W	CON	55%	8%	13%	3%	15%	79%
TUO0154 – Lower S Fork	4,779 W	CON	38%	16%	10%	14%	24%	78%
TUO0157 – S Bald Mtn	5,144 SE	CON	21%	6%	0%	0%	0%	28%
TUO0160 – Brushy Hollow	5,804 S	CON	43%	4%	10%	9%	19%	66%
TUO0161 – Senser Property	3,945 S	CON	1%	91%	0%	0%	0%	92%
TUO0163 – Rushing M	4,355 E	CON	39%	15%	4%	1%	5%	59%
TUO0168 – 65% slope	4,378 E	CON	12%	87%	0%	0%	0%	100%

TUO0170 – Cow Cr Lower	4,858 S	CON	43%	7%	4%	18%	22%	71%
TUO0171 – Pedro Flat	5,060 SW	CON	43%	37%	5%	8%	12%	92%
TUO0172 – Fraser Flat	5,108 E	CON	30%	1%	59%	0%	59%	90%
TUO0189 – Stanislaus Tun	2,816 S	R-H	1%	68%	0%	0%	0%	69%
TUO0190 – Lower Tunnel Cr	3,492 SW	CON	47%	40%	1%	0%	1%	88%
TUO0202 – Upper Knight Cr	3,861 W	CON	2%	93%	0%	0%	0%	95%
TUO0203 – Ruby	4,244 NW	CON	29%	45%	0%	0%	1%	74%
TUO0207 – Upper Tunnel Cr	4,703 SW	CON	45%	35%	3%	7%	10%	90%
TUO0208 – Upper Deer Cr	3,744 SW	CON	26%	51%	0%	0%	0%	77%
TUO0209 – Spring Gap	4,485 SW	CON	28%	38%	3%	29%	32%	98%
TUO0216 – Mile 16	4,889 W	CON	46%	10%	9%	0%	9%	65%
TUO0220 – Campoodle Cr L	5,477 SE	CON	43%	1%	18%	13%	30%	75%
TUO0221 – Horseman Trail	3,134 S	CON	7%	78%	0%	0%	0%	85%
TUO0222 – Mile 22	4,637 E	CON	27%	27%	4%	0%	5%	59%
TUO0223 – Lyons Cr	4,782 SE	CON	35%	26%	16%	8%	24%	85%
TUO0239 – McKee Hill	5,462 S	CON	46%	8%	10%	4%	15%	69%
TOTAL			**29%**	**31%**	**9%**	**4%**	**13%**	**73%**

HRCA (applies only to Alternatives 3 and 4).

The desired conservation outcome for HRCA (USDA Forest Service 2004) is to incorporate the best available contiguous habitat in descending order of priority, CWHR classes 6, 5D, 5M, 4D and 4M and other stands with at least 50 percent tree canopy cover (including hardwoods) within the core area. The acreage in the 300-acre PAC counts toward the total home range core area. Core areas are delineated within 1.5 miles of the activity center.

The greatest proportion of existing HRCAs consists of densified CWHR 4D stands and the majority of HRCAs contain less than 50% in CWHR classes 5 and 6 (Table CSO6). The 4D stands are highly unlikely to develop into greater habitat value of size class 5 and 6 because large-scale high-severity fire or large-scale tree mortality related to drought/insects/disease will likely occur prior to stand development into late-seral mature forest or old growth.

Table CSO6. CSO HRCA existing condition by CWHR size class and density (includes HRCAs partially within SERAL project boundary).

	%CWHR				
HRCA ID	**4M**	**4D**	**5M**	**5D/6**	**Total 5/6**
TUO0004 – Cascade Cr Lower	53%	0%	43%	0%	43%
TUO0005 – Cow Cr Upper	11%	0%	86%	0%	86%
TUO0006 – Strawberry	34%	0%	50%	1%	51%
TUO0014 – Lily Cr D53	12%	0%	87%	0%	87%
TUO0015 – B. Afterbay	44%	32%	15%	9%	24%
TUO0017 – Hart Cr	37%	15%	35%	12%	47%
TUO0018 – Bumblebee	31%	1%	55%	5%	60%
TUO0037 – Dry Meadows	60%	19%	2%	13%	14%
TUO0038 – Smoothwire	29%	27%	8%	36%	44%
TUO0041 – Grant Ridge	52%	40%	0%	0%	1%
TUO0048 – Beardsley N	56%	35%	6%	1%	6%
TUO0049 – Eagle Cr Camp	5%	93%	0%	0%	0%
TUO0050 – Indian Spring	36%	4%	0%	0%	0%
TUO0051 – Schoettgun Pass	25%	25%	8%	5%	13%
TUO0052 – Crandall	22%	60%	4%	13%	18%
TUO0055 – Lower Deer Cr	15%	82%	0%	0%	0%
TUO0056 – Lyons Dam	43%	47%	6%	1%	7%
TUO0057 – N Fork Tuolumne	73%	22%	0%	2%	2%
TUO0058 – Mile 23	43%	50%	0%	0%	0%
TUO0070 – Herring Cr	33%	0%	66%	0%	66%
TUO0093 – Schaeffer M	15%	31%	0%	0%	0%
TUO0094 – MF Stanislaus II	13%	81%	0%	0%	0%
TUO0102 – Campoodle Cr U	84%	0%	7%	7%	14%
TUO0105 – French Camp	3%	43%	0%	0%	0%
TUO0106 – Contention Ridge	9%	60%	0%	0%	0%
TUO0107 – Mid Rose Cr	16%	58%	0%	0%	0%
TUO0108 – Dry Cr	1%	96%	0%	0%	0%
TUO0109 – Deer Cr West	9%	89%	0%	0%	0%
TUO0110 – N Stony Gulch	2%	92%	0%	0%	0%
TUO0114 – Fivemile Cr	1%	76%	0%	0%	0%
TUO0117 – Strawberry N	48%	0%	34%	4%	38%
TUO0136 – Contention Mine	15%	56%	0%	0%	0%
TUO0137 – D51 Girl Mine	2%	93%	0%	0%	0%
TUO0139 – Cedar Ridge	4%	95%	0%	0%	0%
TUO0152 – Upper S Fork	42%	6%	49%	1%	50%

TUO0153 – W Bald Mtn	52%	11%	33%	2%	35%
TUO0154 – Lower S Fork	48%	25%	9%	15%	24%
TUO0157 - South Bald Mtn	62%	7%	26%	1%	26%
TUO0160 – Brushy Hollow	51%	3%	13%	32%	44%
TUO0163 – Rushing M	43%	50%	0%	0%	0%
TUO0166 – Basin Cr D53 Upper	92%	0%	6%	0%	6%
TUO0168 – 65% slope	30%	43%	14%	12%	26%
TUO0170 – Cow Cr Lower	44%	16%	8%	8%	16%
TUO0171 – Pedro Flat	36%	44%	8%	12%	20%
TUO0172 – Fraser Flat	26%	0%	68%	0%	68%
TUO0189 – Stanislaus Tun	2%	92%	0%	0%	0%
TUO0190 – Lower Tunnel Cr	31%	58%	6%	4%	10%
TUO0202 – Upper Knight Cr	5%	93%	0%	0%	0%
TUO0203 – Ruby	34%	61%	0%	0%	1%
TUO0204 - McCormick M	0%	0%	0%	0%	0%
TUO0207 – Upper Tunnel Cr	26%	55%	5%	14%	19%
TUO0208 – Upper Deer Cr	46%	49%	1%	1%	2%
TUO0209 – Spring Gap	23%	41%	2%	34%	35%
TUO0215 – McKee Hill	6%	1%	18%	75%	93%
TUO0216 – Mile 16	37%	33%	17%	13%	29%
TUO0220 – Campoodle Cr L	19%	24%	15%	42%	57%
TUO0221 – Horseman Trail	8%	88%	2%	1%	3%
TUO0222 – Mile 22	48%	43%	2%	0%	2%
TUO0223 – Lyons Cr	50%	25%	8%	13%	22%
TUO0239 – McKee Hill	48%	14%	10%	21%	31%
TOTAL	**29%**	**43%**	**12%**	**6%**	**18%**

Watershed and project (multiple watershed) scale

The desired condition for the watershed scale is to maintain 30 to 50 percent of the watershed at moderate and high canopy cover (e.g., CWHR 6, 5D, 5M, 4D, and 4M). Watersheds are delineated by USGS using a nationwide system based on surface hydrologic features. This system divides the country into 21 regions (2-digit), 222 subregions (4-digit), 370 basins (6-digit), 2,270 subbasins (8-digit), ~20,000 watersheds (10-digit), and ~100,000 subwatersheds (12-digit). A hierarchical hydrologic unit code (HUC) consisting of 2 additional digits for each level in the hydrologic unit system is used to identify any hydrologic area. A HUC 12 watershed is 10,000-40,000 acres.

The existing condition is that all watersheds in the SERAL project area have > 30 percent of the watershed in moderate and high canopy cover (Table CSO7). However, very little (< 7 percent) of the mature tree habitat is in the larger size classes of higher quality habitat (USDA Forest Service 2019). The greatest proportion of habitat within all watersheds is comprised of smaller-statured densified stands (4M,4D). As discussed in the Purpose and Need and elsewhere in the DEIS, smaller-statured densified stands represent lower-value CSO habitat (USDA Forest Service 2019) and are at high risk of tree mortality from large high-severity fire and/or drought/insects/disease (SERAL DEIS). Additionally, the amount of this condition is far outside of NRV (SERAL DEIS).

Table CSO7. Percent CWHR by HUC 12 watershed.

	%CWHR				
Watershed	**4M**	**4D**	**5M**	**5D/6**	**Total**
Cow Creek-Middle Fork Stanislaus River	38%	9%	19%	6%	72%
Dry Meadow Creek-Middle Fork Stanislaus River	27%	33%	1%	3%	64%
Griswold Creek	36%	15%	4%	5%	61%
Lower South Fork Stanislaus River	9%	46%	0%	0%	56%
Middle South Fork Stanislaus River	37%	27%	11%	2%	77%
Mill Creek-Middle Fork Stanislaus River	79%	6%	3%	0%	89%
Rose Creek	15%	47%	0%	0%	63%
Stony Gulch-Stanislaus River	18%	58%	0%	0%	76%
Sullivan Creek	14%	61%	0%	0%	75%
Upper North Fork Tuolumne River	41%	4%	0%	0%	45%
Upper South Fork Stanislaus River	49%	0%	30%	0%	79%
TOTAL	27%	32%	7%	2%	68%

Overall, approximately 9% of lands within the SERAL project area contain high-quality CSO habitat while an additional 58 % contain best-available CSO habitat (Table CSO8).

Table CSO8. Acres of existing high-quality and best-available CSO habitat.

Land Allocation	Total Acres	High Quality	Best Available
PAC	15722	3157	10697
Territory[1]	33987	3422	19080
HRCA[1]	18768	3308	13509
All Other Lands[2]	69098/84318	3887/4001	39531/45103
Total	118808	10466	69308

[1] not including PAC acres.
[2] considering Territories / considering HRCAs.

Risk factors

Risk factors are potential threats to species and habitat that may influence conservation outcomes related to the alternatives considered. The desired conservation outcomes from the Conservation Strategy for the CSO include (USDA Forest Service 2019):

- Non-habitat threats to California spotted owl are minimized.
- Suitable habitat is well distributed and sufficient to support sustainable owl populations. Habitat is resilient to disturbances and climate change, considering NRV and recognizing the Sierra Nevada forests are dynamic ecosystems that will support a range of vegetation types and structures that vary over space and time.
- California spotted owl populations are maintained or enhanced throughout their historic range across the Sierra Nevada forests. California spotted owl populations are maintained across the

range as habitat is transitioned to be more resilient and as ecosystems in the Sierra Nevada are transitioned from the current situation towards NRV and eventually towards the future range of variation.

To help foster climate adaptation of CSO and habitat, the CSO Conservation Strategy calls for managing for cooler, moister forest types at higher elevations to promote sustainable high-quality CSO habitat as climate refugia into the future (USDA Forest Service 2019). The CSO Conservation Strategy additionally calls for proactively augmenting forest resilience through assisted tree gene and species migration for the purpose of developing future CSO habitat resilience under potential future climate conditions. While reforestation is not a proposed action under SERAL because existing conditions do not currently warrant it (see DEIS), such experiments are now underway locally in the Stanislaus-Tuolumne Experimental Forest (Bisbing 2019). When results become available, future forest management actions may incorporate those findings to further benefit CSO and habitat (Ibid.).

Factor 1: Death, injury, and disturbance

Death, injury, and disturbance are non-habitat threats (Figure CSO 5). Other non-habitat threats include Barred Owl (*Strix varia*) invasion from northern California and environmental contaminants from anticoagulant rodenticides associated with marijuana cultivation -- two emerging issues outside the scope of SERAL project alternatives and proposed actions.

Figure CSO 5. Dead spotted owl from Bell Meadow Research Natural Area, 2018 (cause of death was from natural causes).

Death, injury, and disturbance are potential direct effects to consider for spotted owl (USDA Forest Service 2004; 2019). Project activities have the potential to cause death or injury primarily from burning, tree-falling or heavy equipment use. There is the potential for death or injury if nest trees are burned or felled while being used by nesting birds during the reproductive season.

Project activities have the potential to cause disturbance mainly because of the use of loud machinery. Loud noise from equipment such as chain saws or tractors is expected to occur in forest thinning units, project roads, and at landings. Loud noise has the potential to change normal behavior patterns during the period operations would take place and could potentially impair essential behavior patterns of the spotted owl related to breeding, feeding, or sheltering.

The CSO Strategy (USDA Forest Service 2019) provides a summary of the best available science and research findings on noise disturbance and is incorporated below:

Noise associated with nonmotorized activity does not seem to pose a threat to spotted owls. Mexican spotted owls exhibited low behavioral responses of any type to hikers who were at least 55 meters (more than 180 feet) away, and juveniles and adults were unlikely to flush from hikers at distances more than 12 or more than 24 meters (more than 39 or 78 feet), respectively (Swarthout and Steidl 2001). Additionally, owls did not change their behavior when hikers were near nests, although cumulative effects of high levels of recreational hiking near nests are unknown (Swarthout and Steidl 2003).

Chainsaws and helicopter noises do not appear to decrease reproductive success (Delaney et al. 1999) nor increase stress hormones like corticosterone (Tempel and Gutiérrez 2003, 2004). Delaney et al (1999) found no difference in Mexican spotted owl reproductive success when owls were exposed to helicopter and chainsaw noise. Tempel and Gutiérrez (2003, 2004) found no hormonal or behavioral responses of male California spotted owls exposed to chainsaw activity roughly 330 feet (100 meters) from their roost site. Behavioral responses of owls (flushing) occurred only when helicopter or chainsaw disturbance was within roughly 350 feet (105 meters) of the nest and only after young had fledged. Delaney et al. (1999) also found effects to prey delivery rates occurred when disturbance was within roughly 315 feet (96 meters) of the nest and observed alert behavior when helicopters averaged roughly 1,300 feet (403 meters) above the nest. Collectively, these studies suggest chainsaw activity or helicopter flights, particularly 100 meters (or roughly 300 feet) or more from nest sites, have very little potential to impact the CSO.

Hayward et al. (2011) found northern spotted owls closer (less than 100 meters) to low-noise-level roads actually fledged more young than those further away (likely due to increased prey availability around roads), while owls closer to high-noise-level roads fledged fewer young than those further away (likely due to the chronic stress of continuous traffic noise). Wasser and others (1997) reported higher stress levels (indicated by fecal corticosterone) in male northern spotted owls within one quarter of a mile (0.41 kilometers) of a major logging road or recent timber harvest than those further away, but no differences in female hormone levels were found. The authors did not examine hormonal differences relative to distances within a quarter mile of the roads. Hayward et al. (2014) found northern spotted owls exhibit more stress when exposed to motorcycle activities and exhibit lower reproductive success when exposed to busy roads. Tempel and Gutiérrez (2004) found no effect of road proximity on fecal corticosterone levels in CSOs. Hayward et al. (2011) also did not detect an association between hormone levels and distance to roads, though they observed increased hormone levels with acute (1-hour) exposure to traffic noise, particularly in males during the early breeding season (May). Taken together, these studies suggest distance effects are likely site specific and road-type specific, as well as sex specific, and depend greatly on traffic level, among other things. Additional research is needed on if and when road activity negatively impacts owl survival or reproduction.

The following indicator provides a measure (metric) for the above risk factor:

Indicator 1: Potential forest management activities within ¼ mile of activity centers.

This indicator provides a measure to compare and contrast alternatives in relation to the risk factor of death, injury, or disturbance as project activities such as mechanical thinning and prescribed burning may have the potential to cause death, injury, or disturbance.

Metric = acres.

Factor 2: Large, High-Severity Wildfire

Spotted owls evolved in a frequent, low-severity fire regime and are poorly adapted to persist in relatively novel conditions that we are now observing after large fires, with large patches of high-severity burns that basically kill all mature trees and then grow in with high density shrub cover within a few years (Figure CSO 6 A and B, Jones et al. 2020a and 2020b, Jones et al. 2021). Post-fire persistence and colonization may increase in areas with higher pyrodiversity (such as that mimicked by variable-density thinning and/or prescribed fire) because higher pyrodiversity results in conditions that more closely reflect historical postfire conditions -- conditions that maintained nest structures and produced diverse prey habitat and hunting cover (Jones and Tingley 2021, Jones et al. 2020a and 2021, Jones et al. *in press*, Hobart et al. 2021, North et al. 2021, York et al. 2021). Pyrodiversity is the spatial or temporal variability in fire effects across a landscape (Jones and Tingley 2021). Low- to moderate-severity fire does not appear to reduce the probability of spotted owl occupancy (Roberts and North 2012). In contrast, the post-fire environment immediately after large, high-severity fire provides little if any habitat value to spotted owl most likely because of the lack of food and cover (Figure CSO 6 A; also King Fire and Eldorado demographic area examples). Similarly, the 5+ year post-fire environment in severe fire patches also typically lacks tree cover, nest structures, and little in the way of prey availability in the continuous shrub cover that commonly develops (Figure CSO 6 B). From about 1-4 years post fire, in areas within about 325 feet of green forest edge, it appears that spotted owls may temporarily use the edge habitat for foraging in some areas, particularly if severe fire patch size is small and complex in shape (Jones et al. 2020a). Overall, CSO avoid larger patches of severely-burned forest and are adapted to historical frequent-fire regimes of lower-severity with smaller high-severity patches (Jones et al. 2020a and 2021, Kramer et al. 2021, Schofield et al. 2020). In addition to the above recent research, the CSO Strategy (USDA Forest Service 2019) provides a summary of the best available science and research findings on large, high-severity wildfire in relation to the CSO and its habitat and is incorporated here:

Figure CSO 6 A. Post-fire environment following large, high-severity wildfire. An untreated area immediately after wildfire, Stanislaus National Forest, 2018.

Figure CSO 6 B. Post-fire environment following large, high-severity wildfire. An untreated area five years post-fire, Stanislaus National Forest 2018.

Large, high-severity wildfire threatens CSO persistence across the landscape (Peery et al. 2019, Stephens et al. 2016b). A century of fire exclusion has resulted in an ingrowth of shade-tolerant (fire intolerant) trees (e.g., white fir and incense cedar) and an accumulation of surface and ladder fuels, increasing both amount and patch size of high-severity fire in the Sierra Nevada low- and mid-elevation conifer forest types (Mallek et al. 2013, Miller et al. 2009, Steel et al. 2015). Currently, many Sierra Nevada forests are dense and largely homogenous (Hessburg et al. 2005), with high vertical and horizontal fuel continuity; these conditions are conducive to high-severity fire. Recent examples of large, high- severity wildfires overlapping CSO habitat are the 2013 Rim Fire (250,000 acres) and the 2014 King Fire (100,000 acres). From 1993 to 2016, approximately 450,000 acres of forest within the CSO range of the Sierra burned at high severity (USDA Forest Service 2019). Over the same period, approximately 125,000 acres (22 percent) of owl PACs burned across the range, and 32 percent of the burned area was high severity (Keane 2017 updated by USDA Forest Service 2019). Trends in high-severity fire proportion and patch size are likely to continue to increase in the absence of active forest restoration (Stephens et al. 2016).

This year's and last year's (2020 and 2021) record setting fire seasons demonstrate that trends in high-severity fire proportion and patch size continue to increase as well as alarming losses of habitat elements important to mature forest associates such as spotted owl. For example, the National Park Service estimates that over 20% of large (greater than 4 foot diameter) giant sequoia trees have been lost to high-severity fire within just the last two years (there are no sequoia groves in the SERAL project area but this illustrates the concern for large tree loss generally). Another alarming cause for concern is the Dixie Fire of 2021, now the second largest fire in California history. Early assessments of the Dixie Fire indicate that at least half of all owl PACs on the Lassen National Forest have just burned with enough large, high-severity patches as to negatively affect continued owl occupancy and reproduction (Tom Rickman, Lassen NF wildlife biologist, personal communication). Likewise in the Caldor Fire just north of the SERAL project area, preliminary data indicate that at least half of all owl PACs on the Eldorado National Forest have just burned with enough large, high-severity patches as to negatively affect continued owl occupancy and reproduction (Traci Allen, Eldorado NF wildlife biologist, personal communication). In summary, there is a clear and pressing need to increase the pace and scale of active management in the Sierra Nevada immediately to restore resiliency and maintain forested conditions within the Natural Range of Variation (North et al. 2021, Rojas 2021, Safford and Stevens 2017, York et al. 2021).

Fires burn in complex ways and owls likely benefit from low, moderate, and a mixture of fire severities, with smaller high-severity fire patches and edges that create forest heterogeneity (Lee et al. 2012, 2013; Lee and Bond 2015b; Roberts et al. 2011; Jones et al. 2020a; Jones et al. 2020b); however, neither the optimal mix of severity patches nor the optimal spatial configuration of vegetation is precisely known (Keane 2014, 2017). Wildfire is highly variable in nature and so is the response of spotted owls to wildfire effects (Rockweit et al. 2017). Each wildfire has a unique set of factors (for example, pre-fire habitat conditions, time since last fire, overall burn severity, size) and methodologies scientists deploy to analyze owl response (for example, occupancy, demography, habitat use). Patterns of high-severity burn in some fires may increase forest heterogeneity and structural complexity by providing more remnant live trees suitable for owls (for example, Lee and Bond 2015a) while others are more homogeneous and more negatively impact owl sites (for example, Jones et al. 2016b). However, as fire size and the proportion of high-severity fire increases, so does the area within large high-severity patches (Miller et al. 2009) and large, high-severity patches are linked to decreases in spotted owl occupancy, colonization, and habitat use (Eyes 2014, Eyes et al. 2017, Roberts et al. 2011, Tempel et al. 2014a). Large high-severity patches are also linked to increases in owl extinction probability (Jones et al. 2016b, 2020a, 2021). Jones et al. (2016b) showed occupancy of severely burned territories declined substantially, and severely burned areas were avoided by owls, even when foraging. Where greater than half of a territory burned at high severity, territory extinction rates went up seven times, and predicted occupancy declined nine-fold from pre-fire values (Jones et al. 2016b). Stephens et al. (2016) have predicted, based on modeling data, that within the next 75 years, high-severity fire will continue to be a threat to CSO habitat, and the cumulative amount of nesting habitat burned at high or moderate- to-high severity (more than 50 percent basal area mortality) will exceed the total amount of habitat existing today.

The following indicators provide a measure (metric) for the above risk factor:

Indicator 2a: Conditional flame length (CFL) > 8 feet at multiple scales. This indicator provides a measure to compare and contrast alternatives in relation to risk of high-severity wildfire to habitat at multiple scales including PAC, Territory (Alternative 1), HRCA (Alternatives 3 and 4), and project area. Conditional Flame Length (CFL) values are estimates modeled for each pixel, given the condition that a wildfire burns the pixel under different simulated wildfire conditions (see SERAL DEIS for details). A correlation exists between flame lengths and wildfire severity; high-severity (stand-replacing) fire risk is greatest when flame lengths exceed 8 feet, as these flame lengths are commonly associated with tree torching and crown fire initiation (Collins et al. 2013, Stephens et al. 2016).

Metric = acres.

Indicator 2b. Predicted vegetation high burn severity at multiple scales.

This indicator also provides a measure to compare and contrast alternatives in relation to risk of high-severity wildfire to habitat at multiple scales including PAC, Territory (Alternative 1), HRCA (Alternatives 3 and 4), and project area. The Northern California Fire Severity Prediction System (NCFS) was used to assess fire severity probabilities to the existing condition of CSO habitat in the SERAL project area (Drury 2021, https://www.fs.fed.us/psw/programs/ff/staff/sdrury/, Taylor et al. 2021). NFCS is a sophisticated model that uses the latest best available science to produce spatially explicit fire severity prediction maps if a fire were to start during 90th percentile fire weather conditions (typical for late afternoons late July through early

September). Additional details may be found in the DEIS.

Metric = acres.

Factor 3: Large-scale Tree Mortality (related to drought, insects, and disease)

Vegetation management strategies for minimizing habitat loss from water stress and competition will be critical to CSO habitat conservation (North et al. 2017b, USDA Forest Service 2019) in light of what we have learned from recent large-scale tree mortality (Figure CSO 7). Dense stands of conifers, particularly small to medium-sized shade-tolerant trees have become increasingly abundant across Sierran landscapes (Safford & Stevens 2017, USDA Forest Service 2019). These stands are especially vulnerable to drought stress and can lead to insect infestations and disease, as well as fuel high-severity fire (Fettig et al. 2019, USDA Forest Service 2019). Stephens et al. (2018) and Wayman and Safford (2021) found a clear increase in fire severity in areas with tree mortality associated with the 2012-2016 drought in the southern Sierra Nevada.

Figure CSO 7. Recent large-scale tree mortality related to drought and insects in the southern Sierra Nevada.

The CSO Conservation Strategy (USDA Forest Service 2019) provides a summary of the best available science and research findings on extensive drought- and insect-related tree mortality and is included here: Since 2012, there has been a dramatic increase in loss of large trees due to bark beetles in low- to mid-elevation coniferous forests of the southern Sierra Nevada. In the southern Sierra Nevada, the western pine beetle, which is considered one of the principal agents of tree mortality in the Sierra Nevada (Fettig 2012, Fettig and Hilszcanski 2015), has had a widespread impact on ponderosa and sugar pines (USDA Forest Service Aerial Detection Survey Program, 2014-present, unpublished data, Pacific Southwest Region). The synergistic effect of high tree densities, coupled with drought, insects, pathogens, and air pollution, is increasing tree mortality at landscape levels. Expected background levels of tree mortality in the mixed-conifer habitat are roughly less than one tree per three acres annually (USDA Forest Service Aerial Detection Survey Program, 2014-2017 unpublished data, Pacific Southwest Region). Between 2014 and 2017, tree mortality levels increased more than 100 fold in many areas of the southern Sierra (Ibid.). During this period, 55 percent of the PACs on the southern Sierra national forests (Sierra, Sequoia, and Stanislaus) experienced tree mortality of more than 20 trees per acre (Ibid.), with greater loss in larger-diameter trees.

As stated in the CSO Conservation Strategy (USDA Forest Service 2019), extensive drought- and insect-related tree mortality threatens CSO habitat, especially the large trees owls depend upon for nesting and roosting. Recent drought in dense forests has led to severe water stress (Asner et al. 2015, Young et al. 2017), which in turn attracts insects (bark beetles) and increases risks from pathogens and air pollution. CSO habitat overlaps with the western pine beetle, mountain pine beetle, Jeffrey pine beetle, pine engraver beetle, and fir engraver beetle. Depending on the bark beetle species and numerous other factors (Fettig et al. 2007), the extent of tree mortality may be limited to small groups of trees or it may impact extensive areas. These insects are all native to conifer forests of the west, but populations can explode when forests are particularly stressed. Outbreaks occur when favorable forest and climatic conditions coincide, and climate change is likely exacerbating bark beetle impacts (Bentz et al. 2010). Warming temperatures have triggered population increases in many insect species, which have resulted in widespread outbreaks (Millar and Stephenson 2015). Bark beetle infestations are influenced by factors such as overall stand density, tree diameter, tree vigor, fire exclusion, and host species density. Slower-growing ponderosa pines (which are more fire tolerant than other mixed-conifer species) are more susceptible to attacks than other species (Craighead 1925, Miller 1926). For large sugar pine, results from Slack et al. (2021) suggest that forest thinning treatments result in neutral to positive trends in allocation to growth and defense and may contribute to conditions that reduce probability of large tree mortality from bark beetles in the future. Various measures of stand density, including stand density index or basal area, are positively correlated with levels of tree mortality from insects, drought, and disease (Fettig et al. 2012, Hayes et al. 2009, Oliver and Uzoh 1997, Sherlock 2007).

The following indicator provides a measure (metric) for the above risk factor:

Indicator 3: Improved Stand Density Index (SDI) at multiple scales.

This indicator provides a measure to compare and contrast alternatives in relation to the risk factor of large-scale tree mortality related to drought, insects, and disease at multiple scales including PAC, Territory (Alternative 1), HRCA (Alternatives 3 and 4), and project area. Stand Density Index (SDI) is a measure of stand density and competition, which is based on the number of trees per unit area (i.e., trees per acre) and the size of those trees (i.e., the quadratic mean diameter, or QMD, which is the diameter at breast height of a tree of mean basal area). SDI can be thought of as a measure of stem crowding; the higher the SDI, the more crowded the stand. As tree stands become more crowded, tree mortality often increases, especially during drought periods because trees are water-stressed. Lack of precipitation and resulting water stress increases susceptibility of a forest to insect colonization and attack. Any insect infestation or disease may be exacerbated by a lack of precipitation. During a drought, when trees are moisture stressed, they cannot produce sufficient resin flow to resist attack. Any condition that results in excessive demand for moisture (such as tree crowding) or dense understory vegetation, can increase the tree's susceptibility to drought, insects, and disease. High stand densities are contributing toward a reduction in tree and stand health and decreased growth rates. Increased growth rates are necessary to recruit large and very large trees and snags as described in the CSO Conservation Strategy (USDA Forest Service 2019). Strategically planned thinning reduces the SDI and inter-tree competition for resources, allowing the tree's natural defenses to properly function and enhance tree growth and health (Oliver and Uzoh 1997, Sherlock 2007, Slack et al. 2021).

SDI thresholds have been identified to indicate forest susceptibly to bark beetle attacks and disease (see silviculture sections in the DEIS). The higher the SDI value, the greater the likelihood that stands would experience inter-tree competition that will weaken trees, making them susceptible to bark beetle attacks and disease. The result of these conditions will be increased stress and mortality. By reducing SDI in strategically selected locations across the landscape through variable density thinning such as that described by GTR 220 and 237 (North et al. 2009, North 2012, Oliver and Uzoh 1997, Sherlock 2007, Slack et al. 2021), the risk of mortality from large-scale insect attack, disease, and drought can be expected to significantly decrease (Ibid.).

For the SDI metric here, post-treatment modeled estimates for a target SDI reduction were calculated as <330 in fir-dominated stands and <220 in pine-dominated stands (according to the vegetation type from the F3 v16 dataset from ForSys). These thresholds represent targets for effective risk reduction to stand loss from insects, disease, and drought. However, any progress made towards SDI targets will reduce risk of stand loss to insects, disease, and drought (see SERAL DEIS).

Metric = acres projected to achieve SDI target.

Factor 4: Forest Management

Figure CSO 8. Variable density thinning treatment in the Stanislaus-Tuolumne Experimental Forest, 2021.

CSO habitat in the SERAL project area has had various types of forest management but the pace and scale of that management has not matched historical disturbance regimes (North et al. 2012 and 201, US Forest Service FACTS database). Types of forest management include mechanical thinning (Figure CSO 8), salvage, hand thinning, mastication, machine piling, hand piling, and prescribed burning including broadcast burning, jackpot burning, and pile burning (see the DEIS for descriptions of these management actions).

The CSO Conservation Strategy (USDA Forest Service 2019) provides a summary of the best available science and research findings on forest management in relation to the spotted owl and is included here:

The effects of specific forest management activities on spotted owls have a level of uncertainty but overall appear to have a long-term benefit with minimal or at least equivocal short-term impact (Gutiérrez et al. 2017, Jones et al. 2021, Jones et al. *in press*). Research conclusions have been mixed on the magnitude and duration of both negative and beneficial impacts to owl habitat suitability and owl populations from forest management activities. Forest management involves multiple treatments across many different time periods, and this makes drawing conclusions about the effects of an individual management activity type complex. An example is the Seamans and Gutiérrez (2007) study (monitored 66 owl territories from 1990 to 2004), which concluded the probability of occupancy declined 2.5 percent when habitat alteration occurred in more than 50 acres (20 hectares) within a territory. The results in the Seamans and Gutiérrez (2007) study have several limitations: (1) habitat treatments were caused by various types of management (for example, clearcutting, thinning, other prescriptions, fire), and specific impacts of different disturbance types could not be examined independently (for example, logging versus fire); (2) dispersing owls did not necessarily select new territories with higher-quality habitat, as only 53 percent of dispersing owls switched to a territory with higher expected survival; and (3) the authors suggest selection of new territories by breeding individuals was not correlated with mature conifer forest (more than 12 inches DBH and more than 70 percent canopy cover) but may have been associated with mate selection. Stephens et al. (2014) showed the number of occupied CSO territories declined, from 7 and 9, before and during implementation of vegetation treatments (2002 to 2007) to four territories 3 to 4 years after treatments were completed, though longer-term impacts or benefits are unknown. This study had a small sample size and did not compare these patterns to the declines in the surrounding untreated landscape, making general inferences difficult. Similarly, Gallagher et al. (2019) found that sample size limitations made it difficult to draw definitive conclusions regarding forest treatments and foraging patterns in spotted owls. Gallagher et al. (2019) suggest that variation in foraging patterns may be characteristic for California spotted owls given differences among individuals, and prey and habitat availability across territories. Thus, it appears that not all management actions that impact habitat suitability characteristics (such as canopy cover or the abundance of medium-sized trees) should be considered a reduction in habitat quality since the quality of habitat in a given location involves a complex mix of numerous factors. For example, sites at lower elevation and lower latitudes may see an improvement in habitat quality with some reduction from high to moderate canopy cover and some promotion of hardwoods over other species, while similar actions at higher elevations, higher latitudes, and more northern aspects may result in a reduction in habitat quality. Minor reductions in canopy cover (for example, reductions that maintain habitat in the same CWHR class) would not be expected to decrease habitat quality nor would increasing habitat diversity outside 10-acre nest stands through increased variable density or ICO (individual tree, clumps, openings) management. CSOs' selection for tall tree cover is greatest within approximately 10 acres surrounding a nest (North et al. 2017a). Conversely, significantly increasing the proportion of habitat within a PAC that is in the low-canopy-cover class (less than 40 percent canopy cover) is likely to reduce habitat quality. This may occur when treatments such as fuelbreaks are needed. However, landscape-level treatments such as prescribed fire use shaded fuelbreaks as anchor points and extend the zone of altered fire behavior to larger proportions of the landscape. Coupling fuelbreaks with area-wide fuel treatments can reduce the size, intensity, and effects of wildland fires (Agee et al. 2000).

Tempel et al. (2014a and 2016) investigated owl behavior in an area that included the Seamans and Gutiérrez study area but occurred over a longer period and a larger geographic area. Tempel et al. (2014a) found mixed results related to the effect of medium-intensity timber harvest on owls but noted actions that converted mature conifer forest from high canopy cover (more than 70 percent) to lower canopy cover (less than 70 percent) were negatively correlated with demographic parameters. However, the authors found high-intensity timber harvest (for example, clearcutting) appeared to have a weak beneficial effect on owls, likely due to the creation of edges (Tempel et al. 2014a). These studies did not detect a clear adverse impact on owls from timber harvest. Similarly, Irwin et al. (2015) found most harvests had no detectible effect on spotted owls, and the authors did not detect any site abandonment of occupied territories when less than 58 percent of an area was treated.

The lack of impacts detected in these studies may be partially because forest management practices since the early 1990s have not reduced the amount of high-quality habitat found to be most important in determining occupancy over time (Jones et al. 2017). Tempel et al. (2016) concluded forest thinning in CSO territories may maintain habitat quality in the short-term and provide long-term benefits to the species. The authors state: “forest treatments that reduce canopy cover within spotted owl territories, if judiciously implemented, could maintain spotted owl habitat in the short-term so that any long-term benefits as a result of reductions in high-severity fire can be realized.” As the CSO avoid cover in smaller trees (less than 53 feet tall), treatment or harvest that reduces these potential ladder fuels likely maintains or improves owl habitat in both the short and long-term (North et al. 2017a). Examples of treatment or harvest that targets ladder fuels (generally <20” DBH) includes mechanical thinning, hand thinning, mastication, and prescribed fire.

After mass mortality events, salvage for the management of fuel loads may facilitate future forest re-establishment and achievement of NRV goals and may be necessary for hazard abatement to life and property (Fettig et al. 2021, North et al. 2017b, Ritchie et al. 2013, Safford and Stevens 2017, Turner et al. 2019, and SERAL DEIS Purpose and Need). The potential effects of salvage on CSO have been the subject of much debate (Hanson et al. 2018 and 2021, Jones et al. 2016b, 2020b, and 2021, Lee 2020). Some argue that high-severity fire does not have negative effects on owls and that observed negative effects are from salvage (Hanson et al. 2018 and 2021, Lee 2020). Others have shown that large-scale high-severity fire has negative effects on CSO independent of post-fire salvage (Jones et al. 2016b, 2020b, and 2021). Jones et al. 2021 found that the potentially confounding factor, post-fire salvage logging, did not explain variability in the probability of either owls persisting at sites or sites becoming re-colonized; effects could only be attributed to severe fire. The overwhelming scientific consensus that has emerged from this debate is that large-scale high-severity fire is a serious threat to the persistence of CSO, and land managers should implement projects that reduce that threat by reducing fuel loads on the landscape (Jones et al. 2016b, 2020a, 2021, and *in press*, USDA Forest Service 2019). Reducing fuel loads of excess dead trees (i.e., unnatural fuel loadings departed from NRV) can facilitate future forest re-establishment when re-burns occur (Harris and Taylor 2019, Turner et al. 2019) and likely influence the capacity of forests to regenerate under climate change and increasing frequency of high-severity fire (Jones et al. 2021). Thus, active management to mitigate disturbance effects, increase forest resilience and/or restore disturbed areas may be required (Jones et al. 2021, Jones et al. *in press*, North et al. 2012).

In the Sierra Nevada, the regeneration time for old-forest conditions required by spotted owls exceeds 100 years (Jones et al. 2021). However, even a 100+ years hypothesized timeline of habitat regeneration relies on the now questionable assumption that forests will have the capacity to regenerate naturally under climate change and increasing frequency of high-severity fire (Davis et al. 2019, Harris et al. 2020, Shive et al. 2018, Stevens et al. 2017). Figure CSO 6 B (5yr post-fire photo) illustrates how continuous understory fuels and heavy loads of ground fuels can develop in untreated post-fire areas on the Stanislaus National Forest – making the capacity for succession to green mature forest questionable under altered fire regimes or at a minimum, increasing succession time to forested habitat by many decades. Active management to mitigate disturbance effects and increase forest resilience and/or restore disturbed areas may be used to avoid permanent loss of owl habitat in many areas (Jones et al. 2021, Jones et al. *in press*, North et al. 2019). Forest restoration that increases landscape heterogeneity of forest structure and fuels may increase resilience to future disturbances (Koontz et al. 2020). After large-scale tree mortality events, fuel reduction strategies are likely to increase ecosystem resilience and long-term persistence of seasonally dry forests (North et al., 2019) -- and the ecosystem services they provide (Hurteau et al. 2014, Wood and Jones 2019). The accumulating evidence suggests that the conservation of spotted owls, and likely other sensitive wildlife species, and dry forest ecosystem restoration are not in conflict (Jones et al. 2021).

Mosaic habitats created by mixed-severity prescribed or managed fire likely provide benefits to the CSO

(Eyes et al. 2017, Lee et al. 2012 and 2013, North et al. 2021, Roberts et al. 2011 and 2015), while management that creates wide swaths of homogenous open habitat decreases habitat quality and increases avoidance by owls in the near term (Stephens et al. 2014). Habitat homogenization and densification creates departed habitat conditions due to fire suppression and has also likely caused, and continues to cause, habitat loss for the CSO (Gutiérrez et al. 2017, Verner et al. 1992). Variable density thinning treatments followed by prescribed fire provide a pyrosilvicultural pathway to correct departed habitat conditions and better mimic the fine-scale heterogeneity of historic forests --forests under which the CSO and other mature forest habitat associates such as northern goshawk and Pacific marten evolved (Jones et al. *in press*, Jones and Tingley 2021, North et al. 2009, North 2012, North et al. 2021, USDA Forest Service 2014b). Pyrosilviculture is the concept of using prescribed fire to meet management objectives including the use of nonfire silvicultural treatments designed to optimize the incorporation of prescribed fire in the future (York et al. 2020).

The CSO Conservation Strategy (USDA Forest Service 2019) notes that collectively, studies of forest management impacts on CSO habitat and demography suggest there may be tradeoffs in the near term in habitat quality for long-term habitat sustainability, particularly as climate change increases the frequency and severity of habitat disturbances (Stephens et al. 2016, Tempel et al. 2015 and 2016). While forest management that increases heterogeneity and resilience to disturbance may benefit the CSO (Gutiérrez et al. 2017, Jones et al. 2016b, Roberts et al. 2015, Tempel et al. 2016), management that maintains or increases homogeneity or decreases the amount of large/tall tree habitat may come at a near-term cost to current spotted owl occupancy (Stephens et al. 2014). Potential near-term costs of density- and canopy-reduction treatments may be minimized by maintaining or increasing the highest quality large-tree habitat (Wood et al. 2018) and may be balanced by long-term gains when treatments result in increased persistence/sustainability of habitat elements over time (Jones et al. 2017, Stephens et al. 2014, Tempel et al. 2014a and 2015). Research suggests that maintaining microclimate of owl nest stands may be particularly important because sites that are cool and moist may confer some disturbance resilience and because owls appear to prefer microsites that provide nesting and roosting habitat that is cooler and more moist relative to surrounding areas (Jones et al. 2016a, Lesmeister et al. 2019, North et al. 2017a, Steckel et al. 2020). As ten acres is a conservative estimate for the area over which forest structure might influence microclimate (Ma et al. 2010, North et al. 2017a), CSO nest stands are typically defined as a ten acre area immediately surrounding a nest tree or snag (USDA Forest Service 2019). As CSO sites may be considered particularly important ecosystem assets, fuel and density reductions may be carefully applied at multiple scales to achieve more precise control over fire effects (Fernandez et al. 2012, Kerhoulas et al. 2013, Knapp et al. 2017, North et al. 2021, Thomas et al. 2014). For example, areas with high tree density may serve as ladder fuels and potentially interfere with owl foraging while forest heterogeneity at the PAC and Territory scales, with various vegetation communities infused into late-successional forest, may improve spotted owl fitness overall (Roberts and North 2012, USDA Forest Service 2019). Although mechanical treatment exclusion has generally been the rule in PACs, retaining and restoring ecosystem assets in dry, frequent-fire forest types (such as those in SERAL), may be achieved with careful fire reintroduction, and in many cases, mechanical thinning that reduces ladder fuel continuity while emphasizing retention of large overstory trees (North et al. 2009 and 2021).

Numerous empirical studies of the effects of wildfires on areas with prior fuel treatments have shown that fuel treatments are highly effective at reducing wildfire behavior and fire severity in Sierra Nevada forests (e.g., Hurteau and North 2009, Koontz et al. 2020, Krofcheck et al. 2017, North and Hurteau 2011, Safford et al. 2012, Stephens et al. 2009, Stephens et al. 2014, Valliant et al. 2009). Additional studies (Atchley et al. 2021, Banerjee et al. 2020, Bigelow and North 2012, Kennedy and Johnson 2014) have shown that variable density thinning treatments result in 1) lower fire intensity and rate of spread through fine-scale fuel heterogeneity, 2) reduced crown fire potential through the removal of ladder fuels which create a sparse midstory, and 3) insignificant changes in wind effects in lightly to moderately thinned prescriptions. Jones et al. (*in press*) concluded that landscape-scale forest restoration may increase seasonally dry forest ecosystem resilience. Jones et al. (*in press*) noted that thinning and prescribed/managed fire reduced the accumulation of fuels, increased heterogeneity of fuels, promoted development of large, fire-resistant trees, altered fire behavior, reduced severe fire risk, and reduced risk of drought-related tree mortality.

In summary, the best available science indicates that the potential short-term costs of modifying owl habitat (Risk Factor 4) through variable density thinning and prescribed fire is outweighed by the longer-term benefits of reducing the amount of severe fire and insect/disease/drought mortality affecting owl habitat (Risk Factors 2 and 3). This general finding is supported by the best available science (Hessburg et al. 2021a, Hessburg et al. 2021b, Jones et al. *in press*, Prichard et al. 2021, Stephens et al. 2020, USDA Forest Service 2019). This general finding is also supported by local case studies that indicate fuel reduction treatments that include mechanical thinning and/or prescribed fire are compatible with continued owl occupancy and reproduction (Rich 2007). Similarly, case study monitoring of CSO Territory TUO007 in the Stanislaus-Tuolumne Experimental Forest (STEF) in 2021 also showed continued CSO occupancy and reproduction following forest thinning resiliency treatments (see summary on STEF findings below). Thus, the CSO Conservation Strategy (USDA Forest Service 2019) appears to provide a sound approach to forest management that balances the tradeoffs of high-quality habitat retention with necessary forest management treatments to increase resiliency.

Balancing the tradeoffs of high-quality habitat retention with necessary treatments to increase resiliency requires that site-specific research helps inform landscape-level planning (USDA Forest Service 2019). Site-specific research at the local experimental forest helps inform the landscape-level planning in the SERAL project relative to these tradeoffs (https://www.fs.fed.us/psw/ef/stanislaus_tuolumne/index.shtml). These studies are especially valid (also termed high external validity) because they were conducted at the Stanislaus-Tuolumne Experimental Forest (STEF) which is located immediately adjacent to the SERAL project area just 1/2 mile from the boundary in like forest. The first main study was a reference condition study that provided a unique opportunity to compare present forest conditions to reference condition plots that are among the oldest in California (https://www.fs.fed.us/psw/topics/forest_mgmt/methods/). The second main study, called the Variable Density Thinning (VDT) and Prescribed Fire Study, involved a robust before, after, control impact design on variable density thinning and prescribed burning (https://www.fs.fed.us/psw/topics/forest_mgmt/variabledensity/).

Key findings from the first study include (Knapp et al. 2012, Knapp et al. 2013, Knapp 2015, Knapp and Carlson 2021, Lydersen et al. 2013):

- The historical old growth forest consisted of groups of trees, individual large trees, and small gaps. This structure made crown fire uncommon and contributed to the resilience of the forest to wildfire.

- Plots in 2007/08 were 2.4 times denser (299 trees per ac or 739 per ha) than the same plots in the old-growth condition in 1929 (127 trees per ac or 314 per ha).

- Understory shrubs covered 29% of the forest floor in 1929 and only 2% of the forest floor in 2008. Much of this change was likely due to the loss of higher light environments.

- One of the most striking changes was the decline of forest gaps, which in the absence of fire filled with trees. The contemporary forest also lacks the largest most fire resistant trees that were found in historical forests.

- Tree species composition shifted to a higher proportion of white fir and incense cedar, and less pine. Very few small pines were found. In the absence of fire, species such as pines that grow best in high light environments do not regenerate well.

- Over 9 times more standing snags were noted in 2008 and many more logs were found on the forest floor in 2012 than were present in 1929. Contemporary snags and downed logs are generally smaller in size and much of this wood is quite rotten. More numerous, smaller diameter, and more heavily decayed wood has relatively less wildlife value and potentially further increases the fire hazard.

Data from Knapp and Carlson (2021) demonstrates that these changes are similar to those that have occurred in formerly frequent fire forests throughout the western U.S. and that many of the changes can be attributed to the removal of fire from the system (also see North et al. 2009). The added fuels increase forest susceptibility to stand replacing wildfire and helps to explain the behavior of recent fires such as the Rim Fire which burned through similar forests just south of the Stanislaus-Tuolumne Experimental Forest. Forest densification also contributed to the recent drought-related tree mortality event that peaked in the central and southern Sierra Nevada around 2016, killing over 147 million trees (USDA Forest Service Region 5 2021). Loss of forests to disturbance events such as wildfire and drought highlights the need for restoring more resilient conditions (USDA Forest Service 2019).

In light of the findings from the reference plots, Eric Knapp of PSW initiated the Variable Density Thinning (VDT) and Prescribed Fire Study (Knapp et al. 2012). The purpose of the study was to determine if VDT and prescribed fire could restore more resilient conditions, i.e., the conditions under which the CSO and other mature forest associates such as northern goshawk and pacific marten evolved and so are best adapted to (Knapp et al. 2012). This second study was one of the first attempts to implement the latest forestry and fire science described in the landmark "GTR-220" (North et al. 2009) and was also a key subject in the landmark "GTR 237", which translated core GTR-220 concepts into management practice (North 2012).

Key findings from the second study include (Knapp et al. 2017, Knapp et al. 2020, Knapp et al. 2021, Lyderson et al. 2015, NRIS Wildlife, Pickard 2015, Roche et al. 2018, Sollman et al. 2016):

- Breaks in canopy cover were associated with lower fuel loads and may serve to reduce the continuity of surface fuels, thereby affecting the rate and pattern of fire spread to more resilient conditions.

- Variable density thinning held the snowpack longer and exhibited slower melt rates, indicating a possibility to retain substantial amounts of snow in the mountains longer if the thinning structure were to be implemented on a landscape level. Retaining snow in the mountains longer increases water yield and helps ameliorate negative effects of drought to trees.

- Variable density thinning coupled with prescribed burning results in a forest better aligned with the conditions present in historical frequent-fire forests, which were known to be more resilient to both wildfire and drought.

- Variable density thinning significantly reduced evapotranspiration rates for at least five years, thus providing more moisture in forest soils (see also National Science Foundation 2018).

- Thinning reduced the overall mortality rate between 2014 and 2018 from 34% to 11%. A total of 23% of the basal area was lost in the unthinned control treatments during this time period, while basal area was unchanged in the thinned treatments, with growth offsetting mortality.

- Leaving trees at variable spacing (i.e., big trees in clumps), did not appear to compromise growth or resilience of the stand during a drought.
- Prescribed burning consumed surface fuels and lowered fire hazard. With predictions of warmer droughts and greater weather variability, reducing forest density (basal area) and keeping surface fuel loads low will be important for building greater resilience to future drought stress and wildfire.
- Landscape heterogeneity resulting from variable density thinning maintained healthy northern flying squirrel populations, a main prey species of spotted owl.
- Lastly, case study monitoring of CSO Territory TUO007 showed that this territory continues to have CSO occupancy and reproduction occurring with forest thinning resiliency treatments making up 15% of the territory and 21% of the PAC.

In addition to studies at the Stanislaus-Tuolumne Experimental Forest, the effectiveness of fuel reduction treatments was demonstrated locally just north of the SERAL project area in the Donnell Fire of 2018 (Figures CSO 9 A and B), the Rim Fire of 2013 just southeast of the SERAL project area (Figure CSO 10), and at various locations throughout California in 2021 (Figure CSO 11).

In the Donnell Fire, forest thinning treatments and a prescribed managed fire clearly influenced fire severity even in the absence of firefighting resources that had to evacuate to avoid entrapment (i.e., these areas were undefended during the fire and had to "stand on their own"). In short, areas that were treated generally burned at low severity while areas that were not treated burned at high-severity. In contrast to the treatment units, an untreated PAC (e.g., Clark Fork Lower) burned at high-severity during the fire and post-fire surveys indicate that this PAC is now unoccupied (NRIS). This is consistent with findings of Jones et al. 2021. In summary, the effectiveness of forest management treatments in maintaining long-term habitat suitability is largely recognized as effective in maintaining habitat suitability into the future (Jones et al. 2021, Jones et al. *in press*).

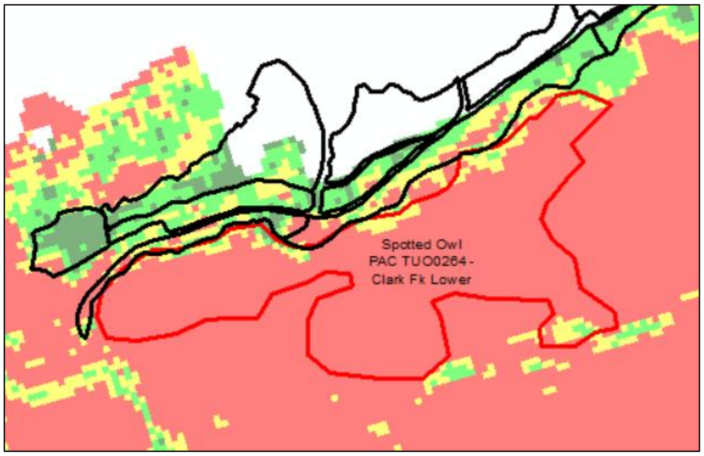


Figure CSO 9 A. Fire severity outcome in an untreated PAC contrasted with fire severity outcome in adjacent mechanical thinning treatments. Scale 1 inch = approximately. ½ mile. Fire severity (red=high, yellow= moderate, green = low, white= not burned in Donnell Fire) in relation to fuel reduction mechanical thinning treatments (black outline) and prescribed managed fire (blue outline) in the Donnell Fire just north of the SERAL project area, 2018.

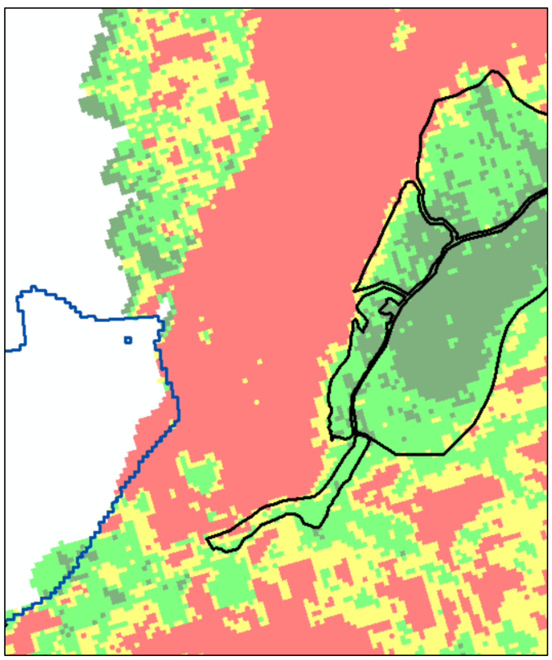


Figure CSO 9 A. Fire severity outcome in an untreated area contrasted with fire severity outcome in adjacent mechanical thinning treatments (black outline) and a prescribed managed fire (blue outline). Scale 1 inch = approximately. ½ mile. Fire severity (red=high, yellow= moderate, green = low, white= not burned in Donnell Fire) in relation to fuel reduction mechanical thinning treatments (black outline) and prescribed managed fire (blue outline) in the Donnell Fire just north of the SERAL project area, 2018.

In the Rim Fire, forest thinning treatments and/or prescribed burning were found to be effective (Crook et al. 2015, Lydersen et al. 2017). Crook et al. (2015) found that treated units greatly assisted structure protection, stand protection, and that overall treated units had reduced fire intensity and fire severity compared to surrounding untreated vegetation (Figure CSO 10). Lydersen et al. (2017) found that areas treated with prescribed fire, especially when combined with thinning, had the lowest proportions of high-severity. Overall, with few exceptions (such as treatment boundaries or small-sized or older treatment units during plume-dominated conditions), fire severity in treated areas of the 2013 Rim Fire was lower than in untreated areas (Lydersen et al. 2014, 2017). These results serve as further evidence that both fuels treatments and lower severity prescribed fire, when implemented at landscape scales, can increase forest resilience (Ibid.).

Figure CSO 10. Mechanical thinning followed by prescribed fire reduced fire intensity as the Rim Fire passed through; fire severity was high in surrounding untreated stands (Crook et al. 2015).

Lastly, the record setting 2021 fire season also presented many examples of how forest thinning treatments and prescribed burning were effective in reducing fire intensity and severity across many fires in the State (Kasler and Sabalow 2021, Figure CSO 11).

Figure CSO 11. Eric Knapp, a U.S. Forest Service research ecologist, stands in late September 2021 between an area of timber burned by the Antelope Fire in Siskiyou County and a test plot that had been thinned more than 20 years ago and had since been treated by two intentionally set fires to clear undergrowth. Knapp said the trees in the test plot largely survived the Antelope Fire, while much of the surrounding forest died (Kasler and Sabalow 2021). Photo credit: R. Sabalow.

The following indicators provide a measure (metric) for the above risk factor:

Indicator 4a: Potential forest management treatment overlap at multiple scales.

This indicator provides a measure to compare and contrast alternatives in relation to forest management treatment overlap by treatment type and multiple scales including PAC, Territory (Alternative 1), HRCA (Alternatives 3 and 4), and project area. This indicator provides a measure to examine alternatives in relation to potential risks and benefits of modifying existing habitat conditions.

Metric = acres.

Indicator 4b: CSO nesting/roosting habitat suitability at multiple scales.

This indicator provides a measure to compare and contrast alternatives in relation to potential changes to nesting/roosting habitat suitability by alternative at multiple scales including PAC, Territory (Alternative 1), HRCA (Alternatives 3 and 4), and project area (multiple watershed).

Metric = acres.

Management Direction

Current Management Direction is provided in the current Forest Plan (USDA Forest Service 2004 as summarized in USDA Forest Service 2017). This direction includes designation of PACs around all known nest stands and the application of standards and guidelines for habitat (USDA Forest Service

2017). A PAC consists of the highest quality habitat in as compact a unit as possible. A limited operating period (LOP) prohibits vegetation treatment and road construction in a quarter mile buffer around an active nest from March 15 through August 15.

Current guidance is provided in the 2019 Conservation Strategy for California Spotted Owl in the Sierra Nevada (USDA Forest Service 2019). The intent of the Strategy is to strengthen the Region's continued efforts for proactive CSO conservation, by providing a strategic framework for active conservation of the California spotted owl on the ten Sierra Nevada Forests within the Pacific Southwest Region. Specifically, the Strategy aims to: (1) increase habitat heterogeneity by introducing more site- and context-dependent recommendations, (2) increase habitat quality at various scales, (3) increase restoration treatments in Protected Activity Centers (PACs), territories, and across the landscape where needed to reduce immediate risk to large-scale disturbance and increase long-term resilience, and (4) manage a dynamic network of PACs while fostering more nesting/roosting habitat in sustainable locations outside of PACs. The Strategy aims to promote and protect the highest quality habitat (large/tall tree-high canopy) while managing the fire-prone and lower quality small/medium tree-high canopy habitat and to minimize non-habitat threats to the CSO. The Strategy recommends using the Natural Range of Variation (NRV) as a reference for restoring a dynamic landscape to move habitat to a more resilient and sustainable condition, to foster the development of additional high-quality habitat, and to promote diverse prey populations for the CSO. The Strategy suggests using information on NRV (much of which is well summarized and synthesized in Safford and Stevens 2017 for the Sierra Yellow Pine/Mixed Conifer) to inform development of desired conditions and outcomes at multiple scales (e.g., number and size of gaps and clumps at multiple scales), as well as to inform retention objectives for key habitat elements (e.g., snags). The Strategy also includes the following NRV-related assumptions: (1) moving towards NRV, and the heterogeneity it includes, will promote a more diverse and robust prey base for the CSO, and (2) while NRV restoration is not an end point, moving conditions towards NRV will move conditions in the right direction for increased resilience under future conditions. The Strategy is a compilation of existing scientific information and a set of management recommendations, only some of which are new. Many of the management recommendations are consistent with current LRMP direction and management priorities. The Strategy clarifies existing desired conditions and Standards and Guidelines from the 2004 SNFPA and adds recommendations to increase habitat resiliency and quality of owl habitat. Alternative 1 adopts the most current and best available science as reviewed and incorporated into the CSO Strategy, while Alternatives 3 and 4 retain the management recommendations of the best available science circa 2004 -- nearly two decades ago.

California Spotted Owl: Environmental Consequences

Direct and Indirect Effects

Table CSO9 compares the indicators across alternatives for California spotted owl.

Table CSO9. Indicators by alternative for California spotted owl (PAC acres are included in Territories and HRCAs; Territories may overlap each other and HRCAs may overlap each other).

	Indicator / Measure	Scale	Alt1	Alt2	Alt3	Alt4
Indicator 1	Acres of potential forest management activity within 1/4 mile of CSO nest stands		4,373	0	3,939	3,799
Indicator 2A	Acres of Conditional Flame Length > 8ft	PAC	2,797	8,304	3,922	4,337

		Territory	6,799	20,989	8,345	8,724
		HRCA	4,161	17,640	5,429	6,010
		Project Area	20,000	48,172	22,107	22,902
Indicator 2B	Acres of High Burn Severity for vegetation	PAC	5,116	10,794	5,561	5,647
		Territory	12,639	28,372	14,177	14,416
		HRCA	7,675	22,859	9,233	9,606
		Project Area	33,254	64,981	36,783	37,453
Indicator 3	Acres of improved SDI to target levels	PAC	2,713	0	388	0
		Territory	13,327	0	8,551	6,283
		HRCA	14,451	0	9,580	6,537
		Project Area	27,419	0	18,947	13,815
Indicator 4A	Acres Forest Thin - Harvest	PAC	3,609	0	849	0
		Territory	12,184	0	4,475	655
		HRCA	12,789	0	5,613	782
		Project Area	26,728	0	11,680	2,550
Indicator 4A	Acres Forest Thin - Other Mechanical	PAC	0	0	0	0
		Territory	1,376	0	5,997	9,318
		HRCA	842	0	4,925	8,881
		Project Area	3,770	0	14,791	22,864
Indicator 4A	Acres - Mechanical Fuel Reduction	PAC	287	0	187	0
		Territory	2,174	0	1,963	1,915
		HRCA	744	0	621	480
		Project Area	7,437	0	7,460	7,448
Indicator 4A	Acres - Fuelbreak	PAC[1]	2,091	0	2,091	2,091
		Territory	6,231	0	6,231	6,231
		HRCA	4,932	0	4,932	4,932
		Project Area	13,430	0	13,430	13,430

Indicator 4A	Acres - Prescribed Fire	PAC	6,873	0	6,873	6,873
		Territory	20,981	0	20,981	20,981
		HRCA	17,328	0	17,328	17,328
		Project Area	43,859	0	43,859	43,859
Indicator 4B	Acres - Highest Quality Habitat	PAC	3,373	3,157	3,161	3,157
		Territory	4,996	6,154	5,800	5,541
		HRCA	4,730	6,340	6,192	5,770
		Project Area	7,820	10,466	10,501	9,883
Indicator 4B	Acres - Best Available Habitat	PAC	10,177	10,696	10,686	10,696
		Territory	19,956	28,559	23,918	24,526
		HRCA	15,662	23,649	19,418	20,337
		Project Area	51,984	69,308	60,195	62,013

[1] these acres are mitigated by the project requirement of adding adjacent acres of comparable quality wherever possible when overlap cannot be avoided.

Indicator 1. Potential management activity within 1/4 mile of CSO nest stands (Table CSO9).

The amount of potential project activity near CSO activity centers is similar across the action alternatives. There are between 3,799 and 4,373 acres of potential treatments within ¼ mile of CSO activity centers across the action alternatives. However, the mobility of the species and the management requirement of LOPs and surveys make it highly improbable that death or injury would occur as a result of project activities. Under no action, death, injury, or disturbance from management actions would not be an issue because no active management would occur. However, under the no action Alternative 2, the probability of high-severity fire would remain high, and so there is a much higher risk wildland fire could cause death, injury, or disturbance to owls over the long-term. Even highly mobile animals such as CSO have been known to become severely burned and/or perish in uncontrolled wildfire situations as appears to have happened in the King Fire (Jones et al. 2021).

Indicator 2A. Conditional flame length > 8ft (Table CSO9) and Indicator 2B. Vegetation High Burn Severity (Table CSO9).

These two indicators show similar results. All action alternatives substantially address the risk of large, high-severity fire by significantly reducing acres subject to conditional flame lengths > 8 feet and significantly reducing acres predicted to burn at high-severity. Alternative 1 clearly performs best at all scales with Alternative 1 showing the most positive outcome for reducing large high-severity fire risk across approximately 1/3 to 1/2 of total PAC acreage at risk.

Under the no action Alternative 2, a significant (thousands of acres) amount of owl habitat at multiple scales would remain at risk of large, high-severity fire and likely rendered unsuitable over the long-term. Under no action, it appears few PACs would be viable long-term were a large uncontrolled wildland fire to occur in the SERAL project area under 90th percentile fire weather (Tables CSO4 and CSO9).

Indicator 3. Improved SDI (Table CSO9).

Action alternatives would result in thousands of acres of reduced tree densities and competition throughout the project area. The resulting improvement in tree vigor and health across the landscape would increase stand resilience to disturbances such as insects, disease, and drought, and would help facilitate the development of larger trees and future high quality wildlife habitat. Each action alternative (Alts. 1,3, & 4) reduces the amount of forest acreage in the "High-risk" category in both mixed-conifer forest types. Alternative 1 is clearly the most effective at reducing both the total acreage and the proportion of conifer forest in the "High-risk" category (from 61% to 26%), followed by Alternative 3 (61% to 37%), and then Alternative 4 (61% to 43%), with the no action Alternative 2 maintaining all of the existing "High-risk" densities. Under no action Alternative 2, existing SDI values in the SERAL project area indicate that the majority of the conifer forest stands (61%, or more than 48,000 acres) would remain at high-risk to density-related mortality in the long-term.

Alternative 1 would still maintain nearly a quarter of conifer forest acreage at densities classified as "High Risk" immediately post-treatment. This is partly due to access issues, but also to leaving the vast majority of PACs at very high stand densities as proposed treatments within PACs are intentionally designed to have a very light touch. PACs account for approximately 16% of the conifer forest in the project area, and 82% of these PAC acres fall into the "High-risk" category for density-related mortality. Not treating any acreage within PACs—as in the cases of Alternatives 2 and 4—would leave thousands of additional acres at extremely high densities, which would likely result in significant overstory loss within PACs over the long-term.

Indicator 4a. Acres of potential forest management overlap by treatment type at multiple scales and Indicator 4b. Acres of predicted status of owl habitat quality (Table CSO9).

Action alternatives vary in relation to the amount of potential forest management overlap. Potential forest management depends on budget and capability constraints. Potential effects may be positive, neutral, or negative as discussed under CSO Risk Factor 4. Alternative 1 treats the most acres at multiple scales for forest thinning and all action alternatives treat the same number of acres for prescribed burning and fuelbreak. In all Alternatives, acres of fuelbreak overlapping PAC are mitigated by the project requirement of adding adjacent acres of comparable quality wherever possible (if overlap with treatment areas cannot be avoided).

Although prescribed burning acres are the same across Alternatives, prescribed fire under Alternative 4 would occur at a slower pace and scale than Alternatives 1 and 3. Forest thinning prior to burning improves the pace and scale of prescribed fire (see discussion in SERAL DEIS). This is especially important if a long time has passed since the last wildfire or vegetation/fuel treatment has occurred, which is the situation for most NFS land in the project area. Prescribed fire implementation only occurs after a range of preparation activities, such as those listed in SERAL DEIS Section 2.03-C. Forest thinning and other mechanical fuels treatments allow a more efficient application of prescribed burning at larger scales and faster rates. Until mechanical treatments or multiple burn entries are completed, prescribed fire must be applied in smaller, more discrete and manageable burn unit sizes to ensure safe ignition conditions are in place. Safe ignition conditions must be in place to mitigate unwanted fire behavior and/or higher severity effects. Thus, Alternative 1 is most likely to achieve desired resiliency outcomes within a realistic time period (see further discussion in SERAL DEIS).

It is important to note that none of the alternatives eliminate high-quality habitat within CSO PACs. Both

Alternative 1 and 3 increase the acres of high-quality habitat within CSO PACs, while the quantity of high-quality habitat remains unchanged in Alternative 4 because no forest thinning is proposed within PACs in that alternative. The slight increase in high-quality habitat acres in PACs in Alternatives 1, and to a lesser degree in Alternative 3, occurs because proposed forest thinning treatments in PACs target smaller trees and intentionally retain larger old-growth trees. For example, Alternative 1 includes a 20" DBH limit as a project requirement for treatments in PACs. Applying this type of prescription converts WHR 4D forests to WHR 5M because by thinning smaller trees and retaining older trees the QMD is increased.

The slightly greater increase in high-quality habitat created within PACs in Alternative 1 demonstrates the effectiveness of the treatment area selection process and shows that the specific PAC forest thinning treatments maintain and promote high-quality CSO habitat in PACs while increasing resiliency across the entire landscape.

The effectiveness of Alternative 1 in maintaining and creating new high-quality habitat within CSO PACs is attributed to use of a metric in the modeling termed "owl departure", developed by Peter Stine (PSW retired), and reviewed by owl scientists. This metric essentially rates CSO habitat conditions on a scale of highest to lowest quality and thus identifies locations that would benefit from treatment while ensuring critical habitat needs of the owl were considered and preserved (see DEIS Appendix E for more details). This metric was calculated from desired CSO habitat as defined by a reference condition of forest density and patchiness, represented by data in Ng et. al (2020). These departed-conditions are primarily made up of only small trees – with no or very few large trees greater than 30" DBH, and/or an excess proportion of dense tree clumps with too few openings.

The intended use of this metric was to allow managers to target limited treatments in PACs to areas of a lower quality habitat — areas containing small trees in dense stands with few openings — in order to reduce the threat of high-severity fire and promote faster recruitment of large trees most effectively. Another intended use of the metric was to ensure that portions of PACs already containing higher quality habitat — large, old, closed-canopy structure — would be maintained.

Treatment area selection within territories (Alternative 1) and HRCAs (Alternatives 3 and 4) were not constrained by the CSO metric described above. Treatments within these areas were instead located to best meet the overall objectives of the project: (1) to correct the landscape's departure from NRV in order to support a more resilient landscape, and (2) reduce the landscape's susceptibility to resource and asset losses due to large scale and high-severity wildfire (as informed by the resilience departure metric and mission oriented expected net value change metric described in more detail in DEIS Appendix E). Alternatives 1 and 4 both would reduce the acres of high-quality habitat in either territories or HRCAs. Allowing a reduction in the quantity of high-quality habitat across the landscape outside of PACs is critical to meeting NRV goals, providing a fine-scale mix of foraging habitat and nesting/roosting habitat, and reducing the landscape's susceptibility to large scale disturbances and loss of habitat. The action alternatives, and Alternative 1 in particular, appear to adequately balance the retention of high-quality habitat with necessary treatments to increase resiliency, which may cause short-term decreases in habitat quality (see discussion under Risk Factor 4).

A similar summary explains why the acres of best-available habitat are reduced among each action alternative in comparison to the existing condition (Alt. 2). Best-available habitat represents areas containing lower quality habitat (e.g., WHR 4D, 4M) which contain smaller and often overly dense stands with few openings. Forested areas composed of smaller trees in high densities are the most vulnerable to high-severity fire and inter-tree competition and are the areas the proposed treatments were intentionally targeted. These areas most often represented the area most in need of treatment and most departed from the natural range of variation. Treatments applied in these areas will promote faster recruitment or growth of large trees to provide future high-quality habitat. The proposed forest management treatements thus maintain and promote high-quality habitat in PACs while concentrating additional treatments within territories, HRCAs, and beyond to help promote NRV goals and having a larger proportion of high-quality habitat across the project area into the future.

CUMULATIVE EFFECTS – ACTION ALTERNATIVES

The cumulative effects discussion outlines those present and foreseeable future activities scheduled on public and private lands.

The Forest queried its databases, including the Schedule of Proposed Actions (SOPA), and other entities (state and private) to determine present and reasonably foreseeable future actions as well as present and reasonably foreseeable future actions on other public (non-Forest Service) and private lands (DEIS Appendix A).

The most pertinent projects to consider for cumulative effects to spotted owl mainly involve reasonably foreseeable vegetation and timber management on private land in the SERAL project area. As stated in the CSO Conservation Strategy (USDA Forest Service 2019), timber harvesting on private lands in the CSO range typically uses even-aged management, like clearcutting, which may reduce spotted owl habitat quality by reducing or eliminating critical habitat elements: high canopy cover and old, large-diameter trees and associated large downed logs (Gutiérrez et al. 2017, McKelvey and Weatherspoon 1992). Recent studies suggest the CSO may occur on private timberlands at a greater density than expected, despite these areas having higher harvest rates (Atuo et al. 2019, Roberts et al. 2017). Roberts et al. (2017) indicate CSO occupancy did not decline over time despite extensive harvest. In other studies, CSOs have been observed avoiding private lands, presumably because of a lack of key habitat elements (Bias and Gutiérrez 1992). Additional work is still required to determine habitat quality on private lands, their contribution to the viability of the regional CSO population, and the long-term effects of even-aged harvest systems (USDA Forest Service 2019).

Management of private land that is reasonably foreseeable in the SERAL project area amounts to approximately 4% of the project area. Four percent is not a significant amount and is highly unlikely to contribute potential negative effects to CSO or any other wildlife species. In addition, the spotted owl is specially managed as per the California Forest Practice Rules (Title 14, California Code of Regulations chapters 4, 4.5, and 10) which govern the regulation of timber harvesting on state and private lands in California. If it is determined that a proposed plan has the potential to harm owls directly or significantly disturb occupied nesting habitat, CDFW works with Cal Fire and the plan submitter to find alternatives and mitigation measures to prevent significant impacts to the species. Sierra Pacific Industries (SPI) also implements a Habitat Conservation Plan (HCP) for the conservation of spotted owl. Similarly, the USFS implements alternatives and mitigation measures to prevent significant impacts as per direction for Regional Forester Sensitive species as described above. Thus, significant cumulative effects are not expected to occur for this species in the SERAL project area. Reasonably foreseeable projects on public lands mainly involve prescribed burning and comprise approximately 8 percent of the SERAL project area. This amount is unlikely to contribute to potential negative effects to CSO or other wildlife.

California Spotted Owl: Determination

ALTERNATIVES 1, 3, and 4

The action alternatives, Alternative 1, 3, and 4, may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the California spotted owl. This determination is based on the following rationale:

- Surveys have been completed and are being kept current as per protocol prior to implementation to ensure activity center protection.
- Prescribed fire, mechanical thinning, and hand thinning prescriptions are designed to increase habitat resiliency from disturbance and scheduled at a pace and scale modeling indicates is effective (most effective under Alternative 1).
- Project requirements are in place to protect owl sites and habitat elements important to owls including LOPs, management activity restrictions in nest stands, DBH limits, and snag and down log requirements.

ALTERNATIVE 2

The no action alternative, Alternative 2, may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the California spotted owl. This determination is based on the following rationale:

- No actions would occur to potentially impact this species or habitat in the short-term. However, with no action to reduce fuels or SDI, high-severity fire and overstory mortality from drought, insects, and disease remains a risk to nesting and roosting habitat and may potentially contribute to a loss of viability long-term.

California Spotted Owl: Consistency with Management Direction

Alternative 1 does not comply with current management direction and would require a forest plan amendment (DEIS Appendix B). Alternatives 3 and 4 comply with current management direction (USDA Forest Service 2017).

Northern Goshawk: Affected Environment

Species and Habitat Account

The northern goshawk (*Accipiter gentilis*) is a Region 5 Forest Service Sensitive species and is also listed with the State of California as a Species of Special Concern. Northern goshawks occur throughout North America and into Mexico. The northern goshawk occurs throughout the Sierra Nevada year-round and breeds from about 2,400 feet to near the crest as well as on the east side of the Sierra (Shuford and Gardali 2006). On the west slope, goshawks use a wide range of habitat types and are considered year-round residents (USDA Forest Service 2004).

The project area is within the current distribution of northern goshawks across the Sierra Nevada Bioregion. Population trends of goshawks in California are poorly known but populations in North America are apparently stable overall with some regional declines possible (Squires et al 2020). Ongoing concern that populations and reproduction may be declining in California due to changes in the amount and distribution of habitat has been documented (USDA Forest Service 2004). Bloom and others (1986) estimated a statewide population of approximately 1,300 breeding territory records on public and private lands. Northern goshawk sites are identified using protocol surveys (USDA Forest Service 2000). Protocol surveys for goshawk have been conducted throughout the SERAL area for the past two decades and protocol surveys are currently underway to keep survey data current (NRIS). There are currently 98 goshawk territories delineated on the Stanislaus National Forest and 15 territories are within the SERAL project boundary.

General habitat requirements for northern goshawks include forested environments with high canopy cover (i.e., greater than 40 percent) that feature vegetation types such as Montane Hardwood, Montane Hardwood Conifer, Ponderosa and Jeffrey Pine, Sierran Mixed Conifer, Lodgepole Pine and Red Fir (CWHR). Goshawks typically nest in areas with a high density of large trees, high canopy cover, high basal area, and gentle to moderate slopes (Reynolds et al. 1992, USDA Forest Service 2004). Breeding typically occurs in late winter to spring and is dependent on elevation and weather conditions. Nest sites are the focal point of goshawk breeding territories and are described by Keane (1999) and Maurer (2000):

- High canopy cover (average 65 to 70 percent).
- Greater number of large, live trees between 24 to 39 inches DBH (average 22 per acre).
- Greater number of large, live trees greater than 24 inches DBH (about 33 to 38 per acre).
- Open understory with low average shrub and sapling cover (about 9.9 percent).
- Low average numbers of small trees in the understory (less than 121 trees per acre and less than 226 trees per acre between 2 to 12 inches DBH).

Goshawks construct stick nests in live conifer, hardwood trees or snags. These nests are typically built in the lower portion of the canopy in a fork or crook of a tree, and often next to the bole (3 to 10 feet) on a large branch (USDA Forest Service 2004). Nest trees are reported to be among the largest trees in a stand (Ibid.). Data from the Stanislaus National Forest show trees ranging from 14 to 65 inches DBH have been selected as nest trees. Goshawks typically build more than one nest, placing alternates in adjacent trees or up to a half mile away (Reynolds et al. 1992). Annual variation in reproduction can be influenced by prey abundance, and by late winter and early spring temperature (Keane 1999).

Goshawks use a diverse array of habitats for foraging, both in terms of vegetation type and the degree of openness (Squires et al. 2020). At the scale of nest-site selection, goshawks nest in the densest stands available, given the capability of the forest type; high canopy closure also appears to be an important habitat characteristic for the species (Hayward and Escano 1989). The size of forest patches used for nest areas appears to be highly variable across the species’ range (Woodbridge and Hargis 2006).

Foraging individuals travel through the forest in a series of short flights, punctuated with brief periods of prey searching from elevated hunting perches (Squires et al. 2020). Goshawks feed on a variety of birds and mammals (Squires et al. 2020). The presence of structural elements such as snags and large downed woody debris provide important habitat for many prey species utilized by goshawks (Reynolds et al. 1992). Foraging habitat preferences of goshawks are poorly understood, although limited information from studies in conifer forests indicates they prefer to forage in mature forests with greater canopy closure and greater density of large trees greater than 40 inches DBH (Bright-Smith and Mannan 1994, Hargis et al. 1994). Reynolds et al. (1992) suggest that goshawks also utilize relatively open shrub and lower canopy layers within forested stands, which may facilitate prey detection and capture.

Both natal and breeding dispersal are not well understood in northern goshawks due, in part, to the complexity of variables associated with dispersal, including the long distances that this species can disperse. Breeding dispersal does occur and has been reported at distances of about three to six miles for females and about two to four miles for males in Arizona and California (Reynolds and Joy 1998, Woodbridge and Detrich 1994). Maximum natal dispersal distances in goshawks on the Kern Plateau were reported to range from 1.7 to 49 miles (Weins et al. 2006). One banded individual from this study was recovered 275 miles beyond the study area, indicating that dispersal distances are highly variable. Local recruits with short dispersal distances have been reported to establish breeding territories within three to five territories from their natal area (Ibid.).

Nonbreeding period home ranges average about 20,300 acres for males and about 13,800 acres for females (USDA Forest Service 2004). Breeding period home ranges average about 6,700 acres for males and about 5,000 acres for females (Ibid.). Adults exhibit site fidelity once breeding territories have been established. This species is not considered migratory, though limited altitudinal movements likely occur during winter months (USDA Forest Service 2004). Goshawks in the Sierra Nevada are year-round residents and expand their breeding ranges in the winter (Keane 1999). As northern goshawks focus their breeding activities around roost and nest sites within PACs and raising young to fledgling status close by, habitat modification effects are expected to be most pronounced in PACs although large landscape scales should be considered to best manage goshawk habitat (Blakey et al. 2020b).

Snags and down woody material function as habitat elements important for goshawk prey and also serve as potential hunting perch sites or plucking posts that may be utilized by goshawks (Squires et al. 2020). Goshawks feed on a variety of prey present in habitat mosaics. In the Sierra Nevada primary prey species are Douglas squirrel, golden-mantled ground squirrel, chipmunks, Steller’s jay, northern flicker, and American robin (Keane 1999).

Forested habitat is required by goshawks for roosting, nesting, and foraging (Bright-Smith and Mannan 1994, Hargis et al. 1994, Reynolds et al. 1992). Loss of breeding habitat from wildfire is known to be a risk factor affecting goshawk persistence in any given landscape (USDA Forest Service 2004). Stand replacing fire events have eliminated nesting territories, but goshawks are known to nest in stands that have experienced understory fires that did not reduce canopy cover and numbers of large trees below suitable levels (USDA Forest Service 2004).

Logging activities near nests can cause failure, especially during incubation (Boal and Mannan 1994). Using heavy equipment too close to active nests can cause abandonment, even when nestlings are 20 days old (Squires et al. 2020). The potential for disturbance may be greatly minimized by LOPs (USDA Forest Service 2004). Mechanical thinning and prescribed fire may result in short-term effects to habitat that are potentially positive, negative, or neutral (Reynolds et al. 1992, USDA Forest Service 2004). Carefully prescribed mechanical thinning has been shown to improve nesting habitat while reducing the risk of overstory loss to large, high-severity fire or insects and disease (Reynolds et al. 1992). In some cases, forest thinning may be necessary to restore forest structure in damaged ecosystems (Squires et al. 2020). Fuels-reduction management (forest thinning) designed to mimic wildfire that maintains historical vegetation patterns has been shown to increase resistance and resilience to high-severity fire (Stephens et al. 2012). Goshawks avoid areas where high-severity fires burned (Blakey et al. 2020a; 2020b) and may ultimately abandon severely burned territories (Reynolds et al. 2017).

Reynolds et al. (2017) summarized goshawk management needs as 1) management of ponderosa pine and mixed conifer forests that is focused on re-establishing the natural vegetation composition (i.e., shade-intolerant, fire-resistant trees), forest structure (moderately even-aged patches of mature and old trees), and spatial pattern (tree patches interspersed within herbaceous and shrub communities) to improve goshawk reproduction and population growth, 2) re-establishing the natural vegetation composition and structure in forested systems to lower the risk of high-severity fire as catastrophic fires have increasingly destroyed goshawk habitat in the western United States, 3) re-establishing natural tree densities to lower among-tree competition and reduce tree shading, both of which should increase the vigor and productivity of overstory and understory vegetation, 4) improving tree vigor to increase the resistance of mixed-conifer forests to insect and disease epidemics, and perhaps resilience to the deeper and longer droughts predicted with climate change (Fulé et al. 2002, Littell et al. 2009, O'Conner et al. 2014, Hessburg et al. 2016), and 5) Increasing habitat diversity, forest productivity, and lowering the risk of catastrophic fire (loss of habitat) as the best management objectives to conserve biodiversity, food webs, and goshawk viability in ponderosa and mixed-conifer forests. In summary, forest management creating a diversity of prey habitats in ponderosa pine and mixed-conifer forests is recommended. The desired habitat diversity includes all tree age classes with a focus on older trees in fine-scale mosaics composed of groups of trees, scattered individual trees, large snags and logs, and small openings with species-diverse and productive herbaceous shrub communities.

PACs

Desired conservation outcomes for PACs are to include 200 acres of the best available forested habitat in as compact an area as possible, comprised of (1) CWHR classes 6, 5D, 5M, 4D, and 4M (listed in descending order of priority); (2) at least two tree canopy layers; (3) dominant and codominant trees averaging more than 24 inches DBH; (4) more than 60 to 70 percent canopy cover; (5) large snags (at least 45 inches DBH); and (6) snag and down woody material levels that are higher than average.

When activities are planned adjacent to non-national forest lands, available databases are checked for the presence of nearby northern goshawk activity centers on non-national forest lands. A 200-acre circular area, centered on the activity center, is delineated. Any part of the circular 200-acre area that lies on national forest lands is designated and managed as a northern goshawk PAC.

PACs are delineated to: (1) include known and suspected nest stands and (2) encompass the best available 200 acres of forested habitat in the largest contiguous patches possible. Where suitable nesting habitat occurs in small patches, PACs are defined as multiple blocks in the largest best available patches within 0.5 miles of one another. Best available forested stands for PACs have the following characteristics: (1) trees in the dominant and co-dominant crown classes average 24 inches dbh or greater; (2) in westside conifer and eastside mixed conifer forest types, stands have at least 70 percent tree canopy cover.

Stands in each PAC have: (1) at least two tree canopy layers; (2) dominant and co-dominant trees with average diameters of at least 24 inches dbh; (3) at least 60 to70 percent canopy cover; (4) some very large snags (greater than 45 inches dbh); and (5) snag and down woody material levels that are higher than average.

The existing condition is that goshawk PACs in the SERAL project area primarily consist of dense stands. While goshawks preferentially select dense stands for screening and cover around nest sites, these same sites are highly fire and disturbance prone (Reynolds et al. 2017, USDA Forest Service 2004). This indicates a need to manage fire risk and overstory loss effectively at the landscape scale. More than half of the habitat in goshawk PACs consists of the densest and most disturbance-prone stands (CWHR 4D and 4M).

Table NGO1. Existing condition of goshawk PACs by CWHR type (percent of acres).

	%CHWR				
PAC ID	4M	4D	5M	5D/6	Total 5/6
Northern Goshawk PAC R05F16D51T06 - Deer Cr	3%	96%	0%	0%	0%
Northern Goshawk PAC R05F16D51T07 - Mt Knight	14%	84%	0%	1%	1%
Northern Goshawk PAC R05F16D51T08 - Spring Gap	50%	22%	0%	28%	28%
Northern Goshawk PAC R05F16D51T13 - Tunnel Cr	41%	58%	0%	1%	1%
Northern Goshawk PAC R05F16D51T14 - SF Stanislaus	24%	35%	6%	36%	42%
Northern Goshawk PAC R05F16D51T19 - Lyons Ridge	32%	22%	22%	21%	43%
Northern Goshawk PAC R05F16D51T28 - Fraser Flat	0%	0%	100%	0%	100%
Northern Goshawk PAC R05F16D52T04 - Campoodle Cr Lower	37%	0%	28%	27%	55%
Northern Goshawk PAC R05F16D52T15 - Smoothwire Cr	3%	23%	0%	73%	74%
Northern Goshawk PAC R05F16D52T42 - Brushy Hollow	54%	24%	0%	0%	0%
Northern Goshawk PAC R05F16D52T52 - Campoodle Cr Upper	72%	0%	11%	14%	25%
Northern Goshawk PAC R05F16D53T07 - Cow Cr Upper	6%	0%	94%	0%	94%
Northern Goshawk PAC R05F16D53T14 – Strawberry	0%	0%	100%	0%	100%
Northern Goshawk PAC R05F16D53T43 – N Beardsley	72%	7%	13%	3%	16%
Northern Goshawk PAC R05F16D53T46 - Cow Cr Lower	12%	33%	13%	42%	55%

Risk Factors

Block et al. (1994), Bloom et al. (1986), Keane and Morrison (1994), Kennedy (1997), Squires et al. (2020), Smallwood (1998), and USDA Forest Service (2001) summarize risk factors potentially influencing the abundance and distribution of northern goshawks:

1. *Loss of Breeding Habitat* - The major threats to goshawks are loss of breeding habitat from wildfire and the effects of intensive logging.
2. *Breeding Site Disturbance* - Breeding site disturbance from logging, human recreation, and falconry harvest can negatively affect individuals and potentially local populations.
3. *Rodenticides and disease* - Investigation of the potential risk of rodenticides is needed.
4. *Climate* - Weather and prey dynamics are primary factors affecting northern goshawk reproduction, and potential survival. Climatic changes resulting in wetter winters and springs can affect northern goshawk demography.

Risk factors 3 and 4 are beyond the scope of the SERAL project and Risk Factors 1 and 2 are synonymous with the four risk factors for California Spotted Owl (see CSO section for further discussion). Reynolds et al. (2017) conclude that managing for forest resilience to the extent possible provides the best chances of conserving goshawk into the future.

Indicators

The following indicators focus the effects analysis on risk factors that relate to project activities. The indicators are based on risk factors described in the best available scientific literature and form a basis for analyzing potential effects and determining how well project alternatives comply with management direction.

Indicator 1: Potential forest management activities within ¼ mile of PACs.

This indicator provides a measure to compare and contrast alternatives in relation to the risk factor of death, injury, or disturbance. Project activities that have the potential to cause death, injury, or disturbance include tree-falling with mechanized equipment (Reynolds et al. 2017). This potential would be greatest within ¼ mile of a PAC.

Metric = acres.

Indicator 2: Conditional flame length (CFL) > 8 feet within 1/4 mile of PACs.

This indicator provides a measure to compare and contrast alternatives in relation to risk of high-severity wildfire to goshawk PACs. While mechanical treatments are avoided within goshawk PACs outside of WUI, treatments within WUI and fuel reduction treatments adjacent to PACs are expected to reduce the risk of high-severity stand-replacing fire to goshawk PACs.

Metric = acres.

Indicator 3: Improved SDI within ¼ mile of PACs.

This indicator provides a measure to compare and contrast alternatives in relation to risk of large-scale drought and conifer mortality. While mechanical treatments are avoided within goshawk PACs outside of WUI, mechanical thinning treatments in WUI and adjacent to PACs for density management improve the Stand Density Index (SDI) in those areas. Improving the SDI in stands decreases the risk of overstory tree mortality to nest stands from “pathogen spillover” of bark beetles (Bulaon, B., Forest Pathologist, pers comm). To significantly reduce this risk, desired conditions for density would depend on forest type and site-specific silvicultural objectives, though maintaining stocking near the lower limit of self-thinning is expected to provide for minimum mortality losses (Sherlock 2007). This lower limit of self-thinning as represented by stand density index (SDI), should generally be less than 220 for pine-dominant stands or 330 for fir-dominant mixed conifer stands (Sherlock 2007).

Metric = acres.

Indicator 4: Potential forest management treatment overlap with PACs.

This indicator provides a measure to compare and contrast alternatives in relation to potential risks of modifying existing habitat conditions. Goshawk PACs within WUI may be mechanically thinned as per forest plan direction (USDA Forest Service 2017); goshawk PACs outside of WUI are avoided and not mechanically thinned. Prescribed burning is allowed in goshawk PACs and hand treatments, including handline construction, tree pruning, and cutting of small trees (less than 6 inches DBH) may be conducted prior to burning as needed to protect important elements of habitat.

Metric = acres.

Management Direction

Current management direction for northern goshawk for all action alternatives is from the Forest Plan (USDA Forest Service 2017). This direction includes designation of PACs around all known nest stands. A PAC consists of the highest quality habitat in as compact a unit as possible. A limited operating period (LOP) that prohibits vegetation treatment and road construction is applied in a quarter mile buffer around an active nest from February 15 through August 31.

Northern Goshawk: Environmental Consequences

DIRECT AND INDIRECT EFFECTS

Table NGO2 shows the relative effects of each alternative on northern goshawk.

Table NGO2. Indicators by Alternative for Northern Goshawk.

Indicator	Metric	Alternative			
		1	2	3	4
Potential forest management activities	Acres of management actions in the surrounding area [1]	7444	0	6926	6780
Acres with CFL > 8ft	Acres of surrounding area [1]	1398	5425	1897	2025
Improved SDI (i.e., lowered to < 220 for pine dominated stands or <330 for fir dominated stands)	Acres of surrounding area [1]	3558	0	2207	1628
Potential forest management overlap with PAC nest stands[2]	Acres	1736	0	1568	1484

[1] within ¼ mile (11,843 total acres surrounding Northern Goshawk PACs).

[2] outside WUI, prescribed fire only with hand treatments, including handline construction, tree pruning, and cutting of small trees (less than 6 inches DBH) prior to burning as needed to protect important elements of owl habitat. Hazard trees may be abated to protect life and property.

Indicator 1. The amount of potential management activity within ¼ mile of PAC nest stands is similar across action alternatives ranging from 6,780 acres to 7,444 acres. The mobility of the species and the management requirement for a LOP within ¼ mile of active nests minimizes the probability that death, injury, or nesting disturbance would occur. Under no action Alternative 2, short-term disturbance from project activities would not occur because no actions would occur. However, the risk of disturbance from high-severity fire would remain high long-term.

Indicator 2. Eight foot flame length probabilities are reduced across 3,400 to 4,027 acres of forest adjacent to goshawk PAC nest stands with Alternative 1 performing best.

Indicator 3. All action alternatives improve SDI in forested areas adjacent to goshawk PACs, reducing risk of overstory loss within PACs, with Alternative 1 performing best.

Indicator 4. There are from 1,484 to 1,736 acres of potential overlapping treatment areas within goshawk PACs. Outside of WUI, treatments are limited to hazard abatement for public safety, prescribed burning, and hand treatments -- including handline construction, tree pruning, and cutting of small trees (less than 6 inches DBH) prior to burning to protect important elements of habitat. Where nest stand habitat cannot be avoided (e.g., hazard abatement), GIS and survey data indicate that sufficient habitat of comparable quality exists in the vicinity such that nest habitat may be re-mapped to avoid intersections with treatment areas or additional acreage of comparable quality may be added to the PAC. Under no action Alternative 2, the risk of high-severity fire and overstory mortality from drought/insects/disease would remain high, and this could negatively affect nesting habitat in the long-term.

CUMULATIVE EFFECTS

The Forest queried its databases, State databases, and others (SERAL DEIS Appendix A) to determine present and reasonably foreseeable future actions as well as present and reasonably foreseeable future actions on other public (non-Forest Service) and private lands (SERAL DEIS Appendix A). Pertinent projects to consider for cumulative effects to northern goshawk mainly involve timber management on private land in the SERAL project area. The northern goshawk is specially managed as per the California Forest Practice Rules (Title 14, California Code of Regulations chapters 4, 4.5, and 10) which govern the regulation of timber harvesting on state and private lands in California. If it is determined that a proposed plan has the potential to harm goshawks directly or significantly disturb occupied nesting habitat, CDFW works with Cal Fire and the plan submitter to find alternatives and mitigation measures to prevent significant impacts to the species. Similarly, the USFS implements alternatives and mitigation measures to prevent significant impacts as per direction for Regional Forester Sensitive species as described above. Thus, significant cumulative effects are not expected to occur for this species in the SERAL project area. Under Alternative 2, no direct cumulative effect is expected from active management because no active management would occur. However, there may be indirect consequences under this alternative related to passive management, primarily related to the continued buildup of forest fuel loads, ladder fuels, and tree density resulting in ever increasing risk of large-scale tree mortality from drought/insects/disease and high-severity fire.

Northern Goshawk: Determination

Alternatives 1, 3, and 4

The action alternatives, Alternative 1, 3, and 4, may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the northern goshawk. This determination is based on the following rationale:

- Surveys have been completed and are being kept current as per protocol prior to implementation to ensure activity center protection.
- Prescribed fire, mechanical thinning, and hand thinning prescriptions are designed to increase habitat resiliency from disturbance and scheduled at a pace and scale modeling indicates is effective (most effective under Alternative 1).
- Project requirements are in place to protect goshawk sites and habitat elements important to goshawks including LOPs, management activity restrictions in PACs, DBH limits, and snag and down log requirements.

Alternative 2

The no action alternative, Alternative 2, may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the northern goshawk. This determination is based on the following rationale:

- No actions would occur to potentially impact this species or habitat. However, with no action to reduce fuels or SDI, high-severity fire and overstory mortality from drought/insects/disease remains a risk to nesting habitat and potentially contribute to a loss of viability long-term.

Northern Goshawk: Compliance with Management Direction

The action alternatives 1, 3, and 4 demonstrate Forest Plan compliance through the following

Alternatives 1, 3, and 4 maintain PACs and require LOPs as described in the Management Direction section. All action alternatives for northern goshawk maintain habitat elements important to goshawk and all action alternatives are required to comply with the current Forest Plan (USDA Forest Service 2017).

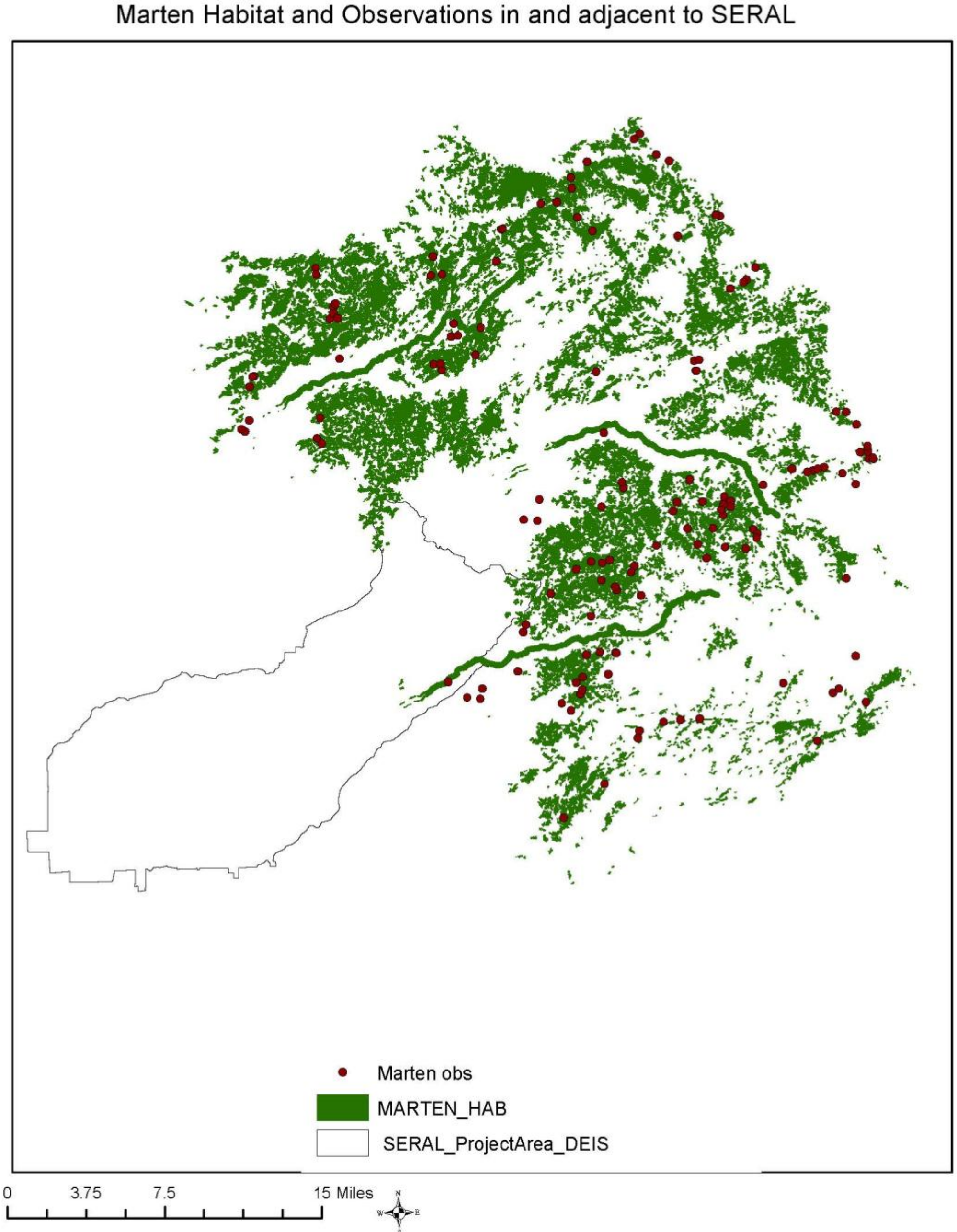
Pacific Marten: Affected Environment

Species and Habitat Account

Pacific marten (*Martes caurina*) is a Region 5 Forest Service Sensitive species that occurs throughout much of its historic range in the Sierra Nevada Mountains (Slauson et al. 2007). Only one detection has been confirmed within the project area from numerous camera and track plate surveys (NRIS). The vast majority of detections have occurred outside the project area in red fir and subalpine habitat (NRIS). All these observations were higher than 5,000 feet in elevation; approximately 76% of the project area is below this elevation.

For this analysis, we considered suitable habitat to be at elevations higher than 5,000 feet since numerous local surveys have been conducted and all local detections were at a higher elevation (NRIS). This elevational cutoff is also similar to what is described in Moriarty et al. (2016). USDA Forest Service (2014b) also states that the marten is most common at higher elevations in true fir and subalpine zones, and USDA Forest Service (2004) says riparian corridors should be considered for assisting with habitat connectivity. We therefore defined suitable habitat as subalpine conifer, red fir, and lodgepole pine with elevation greater than 5,000 feet, size class greater than or equal to 4, and density of M or D. We also included river corridors. Suitable habitat in the project area totals only 1,306 acres (~1% of the project area). The vast majority of suitable habitat is outside of the project area (Figure M1).

Figure M1. Marten habitat and observations in and adjacent to the SERAL project.



USDA Forest Service (2004), largely based on Freel (1991), Slauson (2003), and Spencer et al. (1983) characterized marten habitat and habitat elements as follows:

- Highest quality habitat consists of CWHR types 6, 5D, 5M, 4D, and 4M in descending order of priority.
- Presence of large live conifer groups greater than 24 inches DBH.
- Upper elevation / subalpine forests, riparian corridors, and forest/meadow edges.
- Presence of large snags greater than 30 inches DBH.
- Coarse woody debris averaging 5-10 tons/acre in decay classes 1-2.

Marten natal dens are typically found in cavities in large trees, snags, stumps, logs, shrubs, burrows, caves, rocks, or crevices in rocky areas (USDA Forest Service 1991a; Zielinski et al. 1997; USDA Forest Service 2014b). Dens are lined with vegetation and are found in structurally complex, late succession forests (Buskirk and Ruggiero 1994, Buskirk and Zielinski 1994, USDA Forest Service 2004). Breeding occurs from late June to early August, followed by embryonic diapause, and birth in March-April (Ibid.).

Diet varies by season (Buskirk and Ruggiero 1994). In summer, the diet includes bird eggs and nestlings, insects, fish, and young mammals. In fall, berries and other fruits are important foods. In winter, voles, mice, hares, and squirrels dominate the diet. In California, the marten also consumes hypogenous fungi and may eat reptiles and birds (Zielinski et al. 1983, Zielinski and Duncan 2004). Snowshoe hare and northern flying squirrels may be particularly important prey for marten in California (Zielinski et al. 1983).

Dispersal and migration have not been intensively studied because of the difficulty and high cost of studying long-distance movements in small-bodied mammals (Buskirk and Powell 1994, Ruggiero et al. 1994). The marten exhibits seasonal variation in habitat selection within stable home ranges with little evidence to suggest significant shifts in home range boundaries.

Risk Factors

The following risk factors have the potential to influence marten abundance and distribution (Hargis et al. 1999, Moriarty et al. 2015, Moriarty et al. 2016, and USDA Forest Service 2004, and 2014b):

1. *Habitat fragmentation* –Reductions in habitat connectivity have occurred from intensive logging, largescale high-severity fire, and road construction. These actions/events create openings that martens prefer to avoid, and this can limit occupancy and dispersal across the landscape (Moriarty et al. 2015 and 2016, USDA Forest Service 2014b). In recent years, largescale high-severity fire has increased in the Sierra Nevada, resulting in large areas void of late successional habitat. This trend has amplified concern for old forest associated species like marten (USDA Forest Service 2014b).
2. *Loss of old forest habitat components* – Large trees, canopy cover, snags, and large down wood are important for maintaining prey availability, rest sites, and den sites for marten. Loss of these features has occurred from intensive logging and largescale high-severity fire. Fuel reduction treatments can also reduce marten occupancy if old forest features are not retained (Moriarty et al. 2016). USDA Forest Service (2014b) and Moriarty et al. (2015 and 2016) discuss the balance that is needed between forest treatments that reduce the risk of high-severity fire, and the negative effects that those treatments can have if structural complexity is reduced too much. USDA Forest Service (2014b) concluded that it is logical to treat forests to reduce the severity of fire in proportion to the expectation of catastrophic fires. Potential negative effects of those treatments can be mitigated by conducting fuel treatments mainly at lower elevations less than about 5,000 feet in California (Moriarty 2016, USDA Forest Service 2014b). Negative effects can also be reduced by requiring retention of large trees, canopy, snags, or large down wood (USDA Forest Service 2014b). Utilizing prescribed and managed fire also should be used to reduce fuel loads and produce beneficial ecological effects (USDA Forest Service 2014b).
3. *Meadow habitat degradation* – Fire suppression and over-grazing have decreased meadow health in many areas of the Sierra Nevada. Both activities have led to drier meadow conditions that can reduce the quality of meadow and riparian habitats for foraging marten. In the case of fire suppression, putting out fires has increased survival of coniferous trees and enabled them to

grow in meadows. This takes up space from herbaceous and riparian plants, and it dries meadows out because trees utilize large amounts of water. Fire suppression has also increased the probability of high-severity fire, and this can lead to high velocity water flows that incise stream channels within meadows. This lowers the water table and reduces meadow wetness. Over-grazing can also lower the water table from soil compaction on meadow surfaces, and soil erosion along stream banks.

Risk factors 1 and 2 are synonymous with risk factors for California Spotted Owl and other mature forest associated species (see mature forest associated species sections of CSO, GGO, and goshawk for further discussion). Risk factor 3 is similar to that of GGO (see GGO section for further discussion).

Indicators

The following indicators focus the effects analysis on risk factors that relate to project activities. The indicators are based on risk factors described in the best available scientific literature and form a basis for analyzing potential effects and determining how well project alternatives comply with management direction (see indicator description under other species' headings for further detail on the indicator).

Indicator 1: Potential forest management activities within suitable marten habitat.

Metric = acres.

Indicator 2: Conditional flame length (CFL) > 8 feet within suitable marten habitat.

Metric = acres.

Indicator 3: Improved Stand Density Index (SDI) within suitable marten habitat.

Metric = acres.

Indicator 4: Potential forest management treatment overlap with suitable marten habitat.

Metric = acres.

Management Direction

Current management direction is defined within the Forest Plan (USDA Forest Service 2004 and 2017). Current management direction from USDA Forest Service (2004) states that managers should consider using a proactive approach for improving forest health with management objectives to reduce susceptibility of forest stands to insect and drought-related tree mortality by managing stand density levels. Direction includes establishment of 100-acre den site buffers consisting of the highest quality habitat (CWHR 5D, 5M, 4D, 4M) in a compact arrangement around the den site. There are currently no documented dens in or adjacent to the project area, but if one is discovered, desired conditions around den sites are: (1) at least two conifers per acre greater than 24 inches DBH with suitable denning cavities, (2) canopy closure exceeds 60%, (3) more than 10 tons per acre of coarse woody debris in decay classes 1 and 2, and (4) an average of 6 snags per acre. Standards and guidelines for marten dens are to protect den site buffers from disturbance from vegetation treatments with a LOP from May 1 through July 31 if habitat remains suitable or until another Regionally approved management strategy is implemented. The LOP may be waived for projects of limited scope and duration if the project is unlikely to result in breeding disturbance considering their intensity, duration, timing, and specific location.

From USDA Forest Service (2004 and 2017), direction for down wood is to determine retention levels on a project basis, depending on desired conditions. Large wood in decay classes 1 and 2 should be emphasized. Snag retention should also be determined on a project basis, considering land allocation, desired condition, landscape position, potential prescribed burning and fire suppression line locations, and site conditions, avoiding uniformity across large areas. In westside mixed conifer, ponderosa, and hardwood areas, generally retain 4 of the largest snags per acre. Generally, retain 6 per acre in areas dominated by red fir. Use snags greater than 15 inches DBH to meet this guideline. Consider leaving fewer snags in the Wildland Urban Interface (WUI). When some snags are expected to be lost due to hazard removal or the effects of prescribed fire, consider these potential loses during project planning to achieve desired snag retention levels.

Pacific Marten: Environment Consequences

Table M1 shows the relative effects of each alternative on Pacific marten.

Table M1. Indicators by alternative for Pacific marten (see other species sections in this document for further detail on indicators and metrics).

#	Indicator	Alternative			
		1	2	3	4
1	Potential forest management activities in suitable marten habitat (acres)	950	0	944	932
2	CFL >8 ft in suitable marten habitat (acres)	37	276	25	55
3	Improved SDI to target[1] in suitable marten habitat (acres)	177	0	131	101
4	Potential forest management treatment overlap in suitable marten habitat (acres)	950	0	944	932
4	Potential meadow habitat improvement in suitable habitat (acres)	20	0	20	20

[1] post-treatment modeled estimates were calculated for acres where SDI is reduced to <220 for pine-dominated stands or <330 for fir-dominated stands from thinning treatments.

Indicator 1. The amount of overlap of potential management actions is very similar among the action alternatives (Table M1). There are between 932 and 950 acres of potential treatment activities located within suitable marten habitat across the action alternatives. Death or injury from project related activities would be unlikely to occur given the mobility of this species. The potential disturbance risk to individual marten is considered low because many surveys have been conducted and only one marten has been detected within the project area (NRIS), and only 1% of the project area contains suitable habitat. Also, the management requirement for a LOP if any den sites are discovered minimizes the probability that death, injury, or nesting disturbance would occur in reproductive areas. Under no action Alternative 2, death, injury, or disturbance from management actions would not be an issue because no active management would occur. However, under no action, the probability of high-severity wildfire would remain high, and so there is a much higher risk wildland fire could cause death, injury, or disturbance to marten as even highly mobile animals are known to become severely burned and/or perish in uncontrolled wildfire situations.

Indicator 2. All action alternatives appreciably reduce eight foot flame length probabilities within suitable marten habitat (Table M1). Post-treatment, the action alternatives may be expected to maintain potential overstory loss from large high-severity fire in marten habitat to within NRV parameters. Under no action, about 1/4 of suitable marten habitat has conditional flame length probabilities >8 feet. Thus, under no action, there is a high long-term risk of overstory tree loss to high-severity fire that may be expected in about ¼ of marten habitat in the project area.

Indicator 3. The vegetation type of suitable marten habitat in the SERAL project area is primarily fir-dominated and pine-dominated mixed conifer with fir-dominated mixed conifer being more prevalent. A fir-dominated mixed conifer stand with an SDI value greater than 330, and a pine-dominated mixed conifer stand with an SDI value greater than 220, are indicative of inter-tree competition and stress, making the trees more susceptible to mortality from drought, bark beetle attacks and disease. For the SDI metric here, post-treatment modeled estimates for a target SDI reduction were calculated as < 330 in fir-dominated stands and < 220 in pine-dominated stands (according to the vegetation type from the F3 v16 dataset from ForSys modeled thinning treatments within suitable marten habitat). These thresholds represent targets for effective risk reduction to stand loss from insects, disease, and drought. However, any progress made towards SDI targets will reduce risk of stand loss to insects, disease, and drought. The action alternatives reduce SDI to target levels across a range of approximately 7 percent (Alternative 4) to 10 percent (Alternative 1) of suitable marten habitat. Remaining acres treated would also reduce the risk of stand loss to varying degrees, just not to the SDI target levels described above. Under no action Alternative 2, SDI remains high across nearly all suitable marten habitat. Thus, under no action, overstory loss and structural complexity loss in marten habitat outside NRV parameters may be expected over the long-term from insects, disease, and drought.

Indicator 4. Across all action alternatives, expected forest treatment acres are similar in acreage (Table M1). As the marten is positively associated with dense forest (Moriarty et al. 2015 and 2016, USDA Forest Service 2014b), forest thinning may potentially have short-term negative effects. This effect would most likely be minimal since only 1% of the project area (1,306 acres) is suitable for marten. Many more thousands of acres of suitable habitat are adjacent and outside of the project area. Effects of forest thinning would also be minimized by snag retention requirements, down wood retention, and retention of large trees within thinning units. While any habitat alteration may result in short-term risk by potentially changing habitat suitability, variable density thinning and prescribed burning prescriptions for the SERAL project promote or conserve many habitat elements important to marten such as forest complexity, large trees, hardwoods, snags, and downed logs. Moreover, long-term benefits of habitat resiliency are largely recognized (USDA Forest Service 2014b). In summary, thinning and prescribed burning may cause short-term negative effects to habitat by reducing canopy cover and stand density, but long-term forest resilience would increase by implementing the action alternatives. Retention of snags, large down wood, and large trees would lessen the potential for negative impacts. The number of acres affected by thinning treatments within the project are quite small relative to the total project area, and relative to the number of acres of suitable habitat outside the project area. Therefore, negative effects from forest treatments are expected to be minimal and extremely unlikely to have a measurable effect on the local marten population.

Under the action alternatives, encroaching conifers may be removed in approximately 20 acres of meadow to improve habitat for marten. Expected acres of meadow habitat improvement are the same across action alternatives. However, DBH limits vary. For encroaching conifers in meadows, Alternatives 1 and 3 have a 40 inch DBH limit and Alternative 4 has a 30 inch DBH limit (DEIS Table S-2). Thus, Alternatives 1 and 3 would perform better in maintaining meadow habitat long-term as larger conifers serve as seed sources for conifer encroachment and have higher transpiration rates that may locally affect meadow hydrology and drying. Under no action, loss of meadow habitat to conifer encroachment may occur over the long-term.

CUMULATIVE EFFECTS

The Forest queried its databases, State databases, and others (SERAL DEIS Appendix A) to determine present and reasonably foreseeable future actions as well as present and reasonably foreseeable future actions on other public (non-Forest Service) and private lands (SERAL DEIS Appendix A). Pertinent projects to consider for cumulative effects to marten mainly involve vegetation management on private land in the SERAL project area. There are no reasonably foreseeable actions, such as timber harvest plans on private lands within ¼ mile of suitable marten habitat. The amount of potential suitable habitat for marten is limited in the project area (Figure M1). Thus, significant cumulative effects are not expected to occur for this species in the SERAL project area.

Pacific Marten: Determination

ALTERNATIVES 1, 3, AND 4

The action alternatives, Alternatives 1, 3, and 4, may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the Pacific marten. This determination is based on the following rationale:

- Many surveys for marten have been conducted and only one was detected within the project area (NRIS). The amount of suitable habitat potentially affected is small (~ one percent of the project area), and the vast majority of suitable habitat in the broader area occurs outside of the project.
- These alternatives include actions to reduce fuels and reduce the risk of high-severity fire which may increase the probability of high capability habitat remaining in the future.
- Snag, down wood, and large tree retention requirements would maintain key habitat elements within the forest for marten.

ALTERNATIVE 2

The no action alternative, Alternative 2, may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the Pacific marten. This determination is based on the following rationale:

- This alternative would not result in direct effects from project actions, but fuel levels and risk of large areas of overstory loss from high-severity fire, insects, disease, and drought would remain high. Thus, habitat loss or degradation would likely occur over the long-term.

Pacific Marten: Compliance with Management Direction

Alternatives 1, 3, and 4 follow snag retention and down wood retention guidance in the Forest Plan (USDA Forest Service 2017). Habitat connectivity and maintenance of old forest features are addressed by those snag and down wood requirements, large tree retention, a network of PACs (PACs maintain marten habitat as well as spotted owl, great gray owl, and goshawk habitat) and by considering the South Fork Stanislaus River corridor as suitable habitat for habitat connectivity as discussed in the effects analyses. There are no known dens within the project area, but if one were discovered, the Forest Plan guidance for 100-acre den site buffers and a LOP from May 1 through July 31 would be required.

Fringed Myotis, Pallid, and Townsend's Big-Eared Bat: Affected Environment

Species and Habitat Accounts

The fringed myotis (*Myotis thysanodes*) is a Region 5 Forest Service Sensitive species and is designated as a Species of Special Concern by CDFW. The fringed myotis occurs from southern British Columbia south through the western United States and most of Mexico (O'Shea and Bogan 2003). In California, it occurs from near sea level at the coast to elevations of at least 6,400 feet in the Sierra Nevada and in a variety of habitats from low desert scrub to high-elevation conifer forest (Philpott 1997). The fringed myotis is a widely distributed species and occurs in netting and night roost surveys in a number of localities (Pierson et al. 1996).

The pallid bat (*Antrozous pallidus*) is a Region 5 Forest Service Sensitive species and is designated as a Species of Special Concern by CDFW. The pallid bat occurs in arid regions of western North America from British Columbia to Mexico and east to Wyoming (Hermanson and O'Shea 1983) and is usually found in low to mid elevation habitats below 6,000 feet (USDA Forest Service 2004). Considered yearlong residents, the pallid bat inhabits vegetation types such as Blue Oak Woodland, Mixed Chaparral, and coniferous forests (CDFW 2021b).

The Townsend's big-eared bat (*Corynorhinus towsendii*) is a Region 5 Forest Service Sensitive species and a California species of special concern. Townsend's big-eared bat occurs in low desert to mid-elevation montane habitats throughout the west and are distributed from the southern portion of British Columbia south along the Pacific Coast to central Mexico and east into the Great Plains, with isolated populations occurring in the south and southeastern United States (Kunz and Martin 1982). Townsend's big-eared bat can be found from sea level to 10,000 feet elevation and are considered yearlong residents. Townsend's big-eared bat distribution in California is strongly correlated with limestone caves, old mines, and abandoned buildings (Kunz and Martin 1982, USDA Forest Service 2004). In the Sierra Nevada, Townsend's big-eared bat is associated with vegetation types such as Blue Oak Woodland, Sierran Mixed Conifer, and Montane Riparian (CWHR).

The statuses of pallid, fringed myotis, and Townsend's big-eared bat populations are not well researched, but all populations are thought to have declined over the past several decades (Macfarlane and Angerer 2013, O'Shea and Bogan 2003, Williams 1986). Data from California suggest population declines are associated with habitat loss and disturbance at roost sites (O'Shea and Bogen 2003, USDA Forest Service 2004).

Opportunistic bat surveys have been conducted on the Stanislaus National Forest. All three species have been detected and suitable habitat is present throughout the project area for all three species. (Gellman 1994, NRIS). In California, the fringed myotis occurs in valley foothill hardwood, hardwood conifer, and coniferous forested habitats. In mist netting surveys, fringed myotis are typically found near secondary streams and ponds (NRIS). The fringed myotis roosts in caves, buildings, mineshafts, rock crevices and bridges (O'Farrell and Studier 1980). Studies conducted in California, Oregon, and Arizona, have documented that fringed myotis also roosts in tree hollows, particularly in large conifer snags (Chung-MacCoubrey 1996, Pierson et al. 2006, Rabe et al. 1998, Weller and Zabel 2001). Most of the tree roosts were located within the tallest or second tallest snags in the stand and were surrounded by reduced canopy closure (Ibid.). The fringed myotis exhibits high roost site fidelity, sometimes in different trees but within a small area (O'Farrell and Studier 1980, Weller and Zabel 2001). The fringed myotis is highly sensitive to roost site disturbance (Ibid.). Pallid bats are common in open, dry habitats including grasslands, chaparral, woodlands, and coniferous forests. Pallid bats roost in a variety of locations such as bridges, buildings, caves, rock crevices, mines, and trees (Hermanson and O'Shea 1983). This species can be found singly but is typically gregarious and often found roosting in groups. Pallid bats are sensitive to roost site disturbance which may lead to roost abandonment. All documented occurrences of Townsend's big-eared bats on the Stanislaus National Forest have been in the vicinity of caves, mines, and bridges (Pierson and Fellers 1998, Pierson et al. 2001). One maternity colony has been documented on the Stanislaus National Forest at Bower Cave which is well south of the project area. Townsend's big-eared bat is uncommon and can be found in close association with limestone caves and abandoned mines. Townsend's big-eared bat readily forages in meadow habitat, often associated with willows but can also be found in other habitats including oak woodlands, grasslands, and riparian corridors (USDA Forest Service 2004). Although documented to occasionally use basal hollows of trees in coastal forest dominated by redwood, Douglas fir, and California bay (Fellers and Pierson 2002), this has not been documented in the Sierra Nevada. Snag habitat is not considered typical roosting habitat for this species and a reduction in snag habitat has not been identified as a significant threat to this species (Philpott 1997, USDA Forest Service 2004). While not considered gregarious, Townsend's big-eared bat can be found roosting singly or in groups.

All three species breed in the fall with delayed implantation occurring in the spring. Females form maternity colonies in spring (Zeiner et al. 1990). Pallid bats prefer horizontally-oriented rock crevices as diurnal roost sites in the summer, which coincides with maternity colony selection and use (Hermanson and O'Shea 1983). Townsend's big-eared bats select the warm parts of caves, mines, and buildings for their maternity roosts (Kunz and Martin 1982).

The fringed myotis emerges from roost sites to forage approximately 1-2 hours after sunset and forages in and among vegetation along forest edges and in the overstory canopy (Pierson et al. 2001). The fringed myotis feeds on a variety of insect prey, including small beetles, moths, and fly larvae caught in flight or gleaned from vegetation (Ibid.). Fringed myotis often forage in meadows and along secondary streams. The fringed myotis is known to fly during colder temperatures, precipitation, and even snow (Hirshfeld and O'Farrell 1976, O'Farrell and Studier 1975). Keinath (2004) found that travel distances from roosting to foraging areas may be up to five miles.

The pallid bat forages in open canopied woodlands, riparian areas, and grassland or meadow habitat. This species is maneuverable on the ground and commonly forages between one and five feet above the ground for prey such as Jerusalem crickets, longhorn beetles, scorpions, and occasionally large moths and grasshoppers (USDA Forest Service 2000, Zeiner et al. 1990). The pallid bat readily uses roadways, meadows, oak woodlands, and other open areas to hunt.

The Townsend's big-eared bat takes primarily lepidopteron (moth) prey and is known as a moth specialist (Kunz and Martin 1982, Zeiner et al. 1990). Townsend's big-eared bat forages along forested edges and vegetated stream corridors (Ibid.).

Dispersal patterns for fringed myotis, pallid, and Townsend's big-eared bats are not well researched, but this species is not known to migrate long distances. Pearson et al. (1952) documented an individual Townsend's male that travelled 20 miles. Movements between Townsend maternity colonies and hibernacula have been documented from 1.9 – 24.6 miles (Ibid.).

Fringed myotis are known to hibernate but are also capable of periodic winter activity (Philpott 1997). Pallid and Townsend's big-eared bats are relatively inactive during cold temperatures and either hibernate or enter extended periods of torpor during the winter (Hermanson and O'Shea 1983, Kunz and Martin 1982).

Risk factors for Sensitive species of bats may be found in USDA Forest Service 2017 and other papers cited in this section:

Risk Factors

1. *White Nose Syndrome*- The largest emerging threat to cave-roosting species is the fungal disease white-nose syndrome (WNS). Massive die-offs result once a colony is infected. Because pallid, fringed myotis, and Townsend's big-eared bats readily uses caves for roosting, all are considered

highly susceptible to contracting WNS. WNS is now well-established throughout eastern North America and is rapidly moving west.

2. *Timber Harvest and loss of snags as roosting sites* - The loss of large diameter snags and live trees for roosts due to fire or harvest activities can affect roost availability for pallid bats and fringed myotis. In some forested settings, the fringed myotis appears to rely heavily on tree cavities and crevices as roost sites (Weller and Zable 2001) and may be threatened by certain timber harvest practices that result in the removal of snags. Retention of existing large trees and management of forested habitat will provide short and long-term habitat.
3. *Fire Suppression*- Pallid bats are at risk from loss of open foraging habitat. Fire suppression may reduce foraging habitat in the long-term.
4. *Mining*- The resurgence of gold mining in the West potentially threatens mine dwelling bat species such as fringed myotis, pallid, and Townsend's big-eared bats (Macfarlane and Angerer 2013). Recreational mining exploration has resulted in an increase in roost disturbance and abandonment. Closure of old mines for hazard abatement or safety can reduce habitat availability if mines aren't closed using bat friendly gates.
5. *Rangeland management*- Pallid bats frequently forage in open areas such as oak woodlands. Fringed myotis frequently forage along riparian corridors or over meadows. Overgrazing and trampling may alter meadow hydrology or riparian ecosystems, resulting in reduced insect diversity, productivity, and reducing foraging success (Ferguson and Azerrad 2004; Macfarlane and Angerer 2013).

Risk factors 1, 4, and 5 are outside the scope of the SERAL project proposed actions. Risk factors 2 and 3 are similar to risk factors described under other species such as California spotted owl (see CSO section).

Indicators

The following indicators focus the effects analysis on risk factors that relate to project activities. The indicators are based on risk factors described in the best available scientific literature, and form a basis for analyzing potential effects and determining how well project alternatives comply with management direction.

1. Risk of death, injury, and disturbance.
2. Habitat modification.

Management Direction

The fringed myotis, pallid, and Townsend's big-eared bats are all Region 5 Forest Service Sensitive species. The Forest Plan does not contain specific direction for the management of these species (USDA Forest Service 2017). However, the Forest Plan does provide general guidance for management of Forest Service Sensitive species. This includes managing to ensure conservation or enhancement of these species' populations and habitats to prevent a trend towards Federal listing or a loss of viability. In addition, general direction in the Forest Plan for snag retention protects potential roosting and breeding habitat components, particularly for pallid bat and fringed myotis.

Fringed Myotis, Pallid, and Townsend's Big-Eared Bat: Environmental Consequences

DIRECT AND INDIRECT EFFECTS

Indicator 1. Across the action alternatives, death or injury from project related activities would be unlikely to occur given the mobility of these species. The potential for disturbance from proposed project activities is particularly unlikely for Townsend's big-eared bat since this species roosts primarily in caves, mines, and buildings (Kunz and Martin 1982). Caves, mines, and buildings are not expected to be impacted by this project.

Project activities, especially loud noise from mechanical equipment, could result in disturbance to day roosting bats in trees. Temporary loud noise is expected to occur in fuel and thinning units, prescribed fire units, along roads, and at landings. Smoke from pile or prescribed burning may also impact bats that are roosting close to burning activities. However, these species are highly mobile and alternate roost sites are abundant across the landscape. It is unlikely that females would abandon their young due to their ability to carry pups from roost to roost during normal roost-switching behavior. The tendency for bats to switch roosts under normal circumstances would preclude this from causing negative effects to reproduction. LOPs in place for spotted owls, goshawks, and great gray owls would afford protection to bats roosting in these areas in the spring and summer months. Foraging behavior would not be affected because bats are primarily nocturnal. Under no action, death, injury, or disturbance would not occur from project activities, but may occur if an uncontrolled wildfire occurred. The risk of large and high-severity wildfire within the project area would remain high long-term under no action Alternative 2. Bats are more resilient to high-severity fire than some other species (Steel et al. 2019), but a large scale high-severity fire would reduce the amount of forested roosting habitat.

Indicator 2. Fuel reduction and thinning treatments may result in a minor reduction of roost sites available for pallid bats and fringed myotis. Potential forest management would not likely be an issue for the cave, mine, and building roosting Townsend's big-eared bat. DBH limits and selective thinning, as opposed to clear-cut logging, would help to maintain large trees and forest structure at a landscape scale. The forest habitat would be more resilient long-term. A minimum of 4 snags per acre would be retained (except in fuel breaks) and this would continue to provide roost sites across the landscape. Suitable habitat outside, adjacent to, and within treatment units would continue to provide potential roost sites interspersed with foraging habitat in the short and long-term. Prescribed fire would likely benefit bats since fire suppression and forest densification are thought to have caused population declines (Steel et al. 2019). Overall, the action alternatives would maintain bat habitat because the forest would be more resilient to large scale overstory loss. Potential activities would vary spatially and temporally so suitable habitat outside, within, and adjacent to treatment units would continue to provide potential roost sites interspersed with foraging habitat in the short and long-term.

CUMULATIVE EFFECTS

The STF Schedule of Proposed Actions (SOPA) was searched and inquiries were sent to adjacent land managers to determine present and reasonably foreseeable future actions on STF land, other public land, and private land.

Federal Lands: There are several sources of noise disturbance that occur throughout the forest and include activities such as timber harvest, mastication, prescribed fire operations, restoration, and recreation. These activities vary in intensity, duration and scope and are not expected to be concentrated enough to have a measurable impact on bat populations.

Private Lands: There are approximately 390 acres of Timber Harvesting Plans being implemented throughout the SERAL project area, mostly around the Lyons Reservoir Area. Timber harvest on private lands may remove some potential roost trees for bats but this area is small relative to the project area and roost habitat would remain abundant at the landscape scale. Some harvest on private land may include clear cuts and that would increase foraging habitat as these three species forage in openings. Overall, the landscape would remain suitable for all three species. Thus, the action alternatives are not expected to add significant cumulative effects on fringed myotis, pallid bat, and Townsend's big-eared bat. Under no action Alternative 2, short-term effects would not result from project activities (no actions would take place). However, the risk of large-scale disturbances outside NRV parameters would remain high for these three species of bats in the long-term.

Fringed Myotis, Pallid, and Townsend’s Big-Eared Bat: Determination

Alternatives 1, 3, and 4

Alternatives 1, 3, and 4 may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the fringed myotis, pallid bat, or Townsend’s big-eared bat. This determination is based on the following rationale:

- Much of the current landscape has become increasingly dense with conifers from a century of fire suppression, and bat habitat has likely decreased as a result (Steel et al. 2019). Fuel reduction treatments would decrease stand density, increase forest resiliency, and decrease encroaching conifers around meadows. Important components of bat habitat would be retained with snag retention requirements and DBH limits. Overall, these species are likely to benefit from forest resiliency treatments in the long-term.

Alternative 2

Alternative 2 may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the fringed myotis, pallid bat, or Townsend’s big-eared bat. This determination is based on the following rationale:

- No actions would occur to alter habitat in the short-term. However, the risk of large-scale forest loss would remain high on much of the landscape and this is unlikely to benefit these three species of bats long-term.

Fringed Myotis, Pallid and Townsend’s Big-Eared Bat: Compliance with Management Direction

The action alternatives comply with current management direction (USDA Forest Service 2017). Proposed treatments maintain elements of bat habitat in and around treatment units, such as large trees and snags, and proposed treatments would result in a habitat mosaic beneficial for these three species of bats.

Western Bumble Bee: Affected Environment

Species and Habitat Accounts

The western bumble bee (*Bombus occidentalis*) is a Region 5 Forest Service Sensitive species. The western bumble bee occurs throughout California and in all states adjacent to California. Historically, the western bumble bee was one of the most broadly distributed bumble bee species in North America (Cameron et al. 2011). Currently, the western bumble bee is experiencing severe declines in distribution and abundance due to a variety of factors including disease and loss of genetic diversity (Cameron et al. 2011, Koch et al. 2012). Graves et al. (2020) documented a continued and large decline (93%) in the probability of occupancy of *B. o. occidentalis* across the western United States in the last 21 years. The overall status in the west is largely dependent on geographic region: populations west of the Cascade and Sierra Nevada mountains are experiencing steep declines, while those to the east of this dividing line are more secure with relatively unchanged population sizes. The reasons for these differences are not known.

There are no records of western bumble bee on the Stanislaus National Forest. The nearest documented western bumble bee was approximately 25 miles from the project area in Yosemite National Park at Lake Eleanor in 1983 (Thorp et al 1983). The project area is not known to be within the current distribution of the western bumble bee in the Sierra Nevada Bioregion, but thorough surveys on the Stanislaus have not been conducted. Habitat considered suitable for western bumblebee includes montane, mixed-forest, chaparral, annual and perennial grassland, and wet meadows.

The following account of bumble bee life history is summarized from Heinrich (1979): Queens overwinter in the ground in abandoned rodent (e.g., mouse, chipmunk, or vole) nests at depths of 6- 18 inches and typically emerge about mid-March. The queen then lays fertilized eggs and nurtures a new generation. The queen first creates a thimble-sized and shaped wax honey pot, which she provisions with nectar-moistened pollen for 8-10 individual first-generation workers. The larvae receive all the proteins, fats, vitamins, and minerals necessary for growth and normal development from pollen. Eventually, all the larvae will spin a silk cocoon and pupate in the honey pot. The workers that emerge will begin foraging and provisioning new honey pots as they are created to accommodate additional recruits to the colony. Individuals emerging from fertilized eggs will become workers that reach peak abundance during July and August. Foraging individuals are largely absent by the end of September. Those that emerge from unfertilized eggs become males, which do not forage and only serve the function of reproducing with newly emerged queens. When the colony no longer produces workers, the old queen will eventually die, and newly emerged queens will mate with males and then disperse to start new colonies. During this extended flight that may last for up to two weeks she may make several stops to examine the ground for a suitable burrow. Unlike all other bees, bumble bees are large enough to be capable of thermoregulation, which allows them to maintain their foraging activities for longer periods of the day, but also to occupy regions with more extreme latitudes and temperatures compared to other bees. Bumble bees may continue to forage when temperatures are below freezing even in inclement weather. Queens end the year by locating a sheltering burrow, where they may spend the winter months under cover.

Bumble bees are central place foragers, meaning individuals rely on exploration from a home-base to find resources (Osborne et al. 2008). Bees may communicate with chemical cues to fellow nest mates signaling the presence of a good food source (Dornhaus and Chittka 2001 and 2004). The western bumble bee is a generalist forager, meaning it does not rely on any one flower or flower type. However, the western bumblebee has a short proboscis or tongue length relative to other co-occurring bumble bee species, which restricts nectar gathering to flowers with short corolla lengths and limits the variety of flower species it can exploit.

Risk Factors

1. *Non-native bumble bee species introductions*- Bumble bees introduced from Europe for commercial pollination apparently carried a microsporidian parasite, *Nosema bombi*, which has

been introduced into native bumble bee populations. Incidences of declining *B. occidentalis* populations are associated with high infection rates with the *Nosema* parasite, and the incidence of *Nosema* infection is significantly higher in the vicinity of greenhouses that use imported bumble bees for pollination of commercial crops (Cameron et al. 2011).

2. *Grazing*- According to studies done in England (Goulson et al. 2008), grazing during autumn and winter months may provide excellent bumblebee habitat and prevent the accumulation of coarse grasses. Heavy grazing and high forage utilization should be avoided since flowering plants that provide necessary nectar and pollen may become unavailable, particularly during the spring and summer when queens, workers, and males are all present and active.
3. *Habitat fragmentation and alteration*- Bumble bees may be affected by habitat alteration that reduces the availability of flowers and decreases the number of abandoned rodent burrows.
4. *Fire suppression*- In the absence of fire, native conifers encroach upon meadow habitat which decreases habitat available for bumble bees.
5. *Development*- Agricultural and urban development can reduce habitat available for bumble bees. Exposure to organophosphate, carbamate, pyrethroid, and particularly neonicotinoid insecticides has recently been identified as a major contributor to the decline of many pollinating bees, including honeybees and bumble bees (Henry et al. 2012, Hopwood et al. 2012, Krupke et al. 2012).

Risk factors 1, 2, and 5 are outside the scope of SERAL proposed actions. Risk factors 3 and 4 are similar to the risk factors for other species considered in this document (see other species' sections for details).

Indicators

The following indicators focus the effects analysis on risk factors that relate to project activities. The indicators are based on risk factors described in the best available scientific literature and form a basis for analyzing potential effects and determining how well project alternatives comply with management direction.

1. Risk of death, injury, and disturbance.
2. Habitat modification.

Management Direction

The western bumble bee was designated as a Region 5 Forest Service Sensitive species in 2013. Thus, the Forest Plan does not contain specific direction for the management of this species. However, the Forest Plan provides general guidance for management of Forest Service Sensitive species (USDA Forest Service 2017), and a document written by the USDA and USDI (2015) provides information on best management practices for pollinators on Federal lands. Direction is to ensure conservation or enhancement of populations and habitats to prevent a trend towards Federal listing or loss of viability.

Western Bumble Bee: Environmental Consequences

DIRECT AND INDIRECT EFFECTS

Indicator 1. Western bumble bees have not been documented on the STF, but if present, death or injury from forest management activities could potentially occur because this species nests and overwinters underground in abandoned rodent burrows (Hatfield et al. 2012). Prescribed burning could also result in injury or death of overwintering queens if the nest is not deep enough to withstand the residual heat at the soil surface. These effects would be limited to areas within treatment units. Because treatments would not occur throughout the project area all at once, some areas would remain undisturbed while other areas are being treated. Under no action, risk of large high-severity fire would remain high which may contribute to large-scale risk of death, injury, or disturbance over the long-term.

Indicator 2. Forest management effects are likely overall beneficial because managing towards NRV conditions would mimic the conditions under which the western bumble bee evolved. Additionally, potential treatments vary spatially and temporally. For example, prescribed fire treatments do not occur all at once and do not result in 100 percent consumption of vegetation. Prescriptions call for a mosaic burn in which some vegetation is left intact. Similarly, thinning treatments would vary in space and time and would allow more sunlight for flowers on the forest floor (USDA Forest Service/USDI 2015). Habitat within treatment areas would generally return quickly since many flowering plants that the western bumble bee relies on are early successional species. Therefore, some herbaceous and woody vegetation would remain available to bees throughout the landscape in space and time. Under no action Alternative 2, direct habitat modification from project activities in the short-term would not occur because no actions would occur. However, the landscape would remain vulnerable to large-scale change and the landscape would move further from NRV conditions – conditions under which the western bumble bee evolved. Therefore, the western bumble bee would be unlikely to benefit from no action Alternative 2 in the long-term.

CUMULATIVE EFFECTS

The STF Schedule of Proposed Actions (SOPA) was searched and inquiries were sent to adjacent land managers to determine present and reasonably foreseeable future actions on STF land, other public land, and private land. These actions primarily involve vegetation management that vary spatially and temporally. Habitat in treatment areas would generally recover quickly since many flowering plants that the western bumble bee relies on are early successional species. Additionally, habitat would remain available for bees during implementation because treatments would not occur all at once and suitable habitat would exist outside of proposed treatments throughout the SERAL project area.

Western Bumble Bee: Determination

ALTERNATIVES 1, 3, AND 4

The action alternatives, Alternatives 1, 3, and 4, may affect individuals but are not likely to result in a trend toward Federal listing or loss of viability for the western bumble bee. This determination is based on the following rationale:

- Habitat in treatment units would generally recover quickly since many flowering plants that the western bumble bee relies on are early successional species.
- Habitat would remain available for bees during implementation because treatments would not occur all at once and treatments would vary spatially and temporally.

ALTERNATIVE 2

The no action alternative, Alternative 2, may affect individuals but is not likely to result in a trend toward Federal listing or loss of viability for the western bumble bee. This determination is based on the following rationale:

- There would be no direct modification of suitable habitat, but the project area would likely move away from NRV conditions and this would be unlikely to benefit the western bumble bee in the long-term.

Western Bumble Bee: Compliance with Management Direction

Action alternatives would provide landscape conditions likely to benefit the western bumble bee and thus would comply with current management direction.

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